# A Whole New World;
# HD IVUS


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**The Catholic University of Korea**

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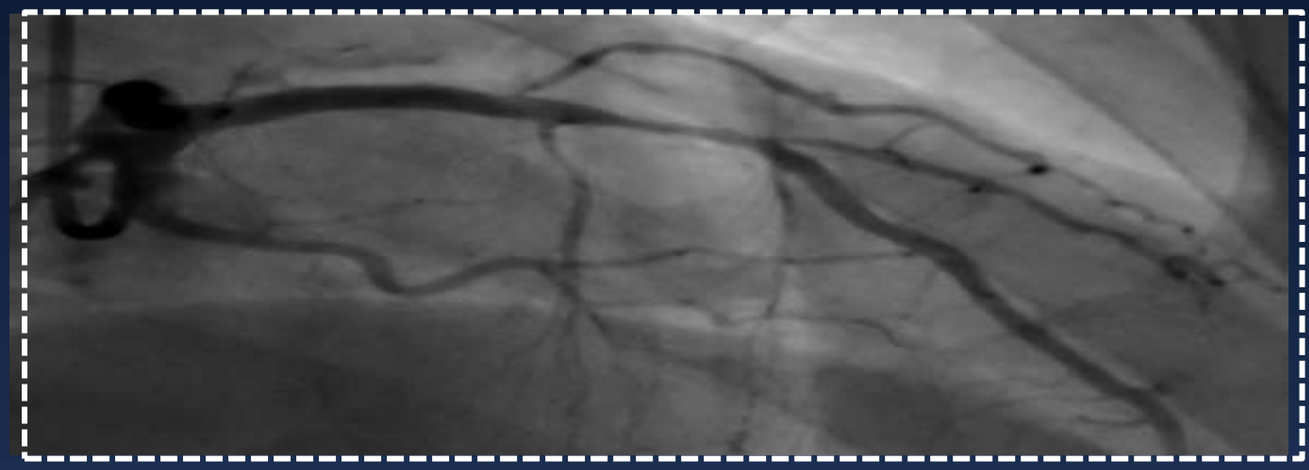
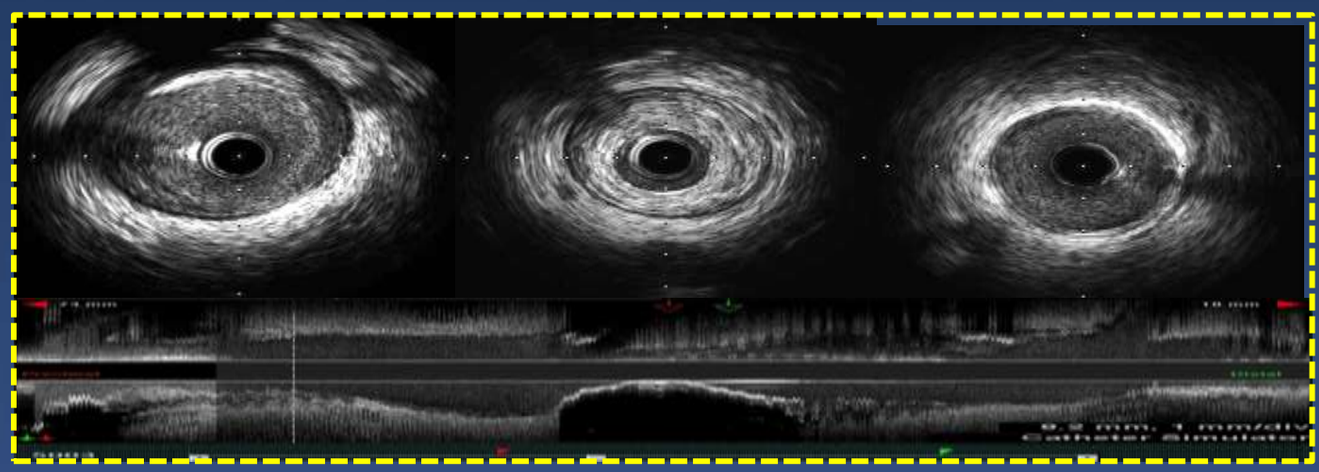
- ✓ Background
- ✓ HD IVUS
- ✓ CASE image
- ✓ Conclusion

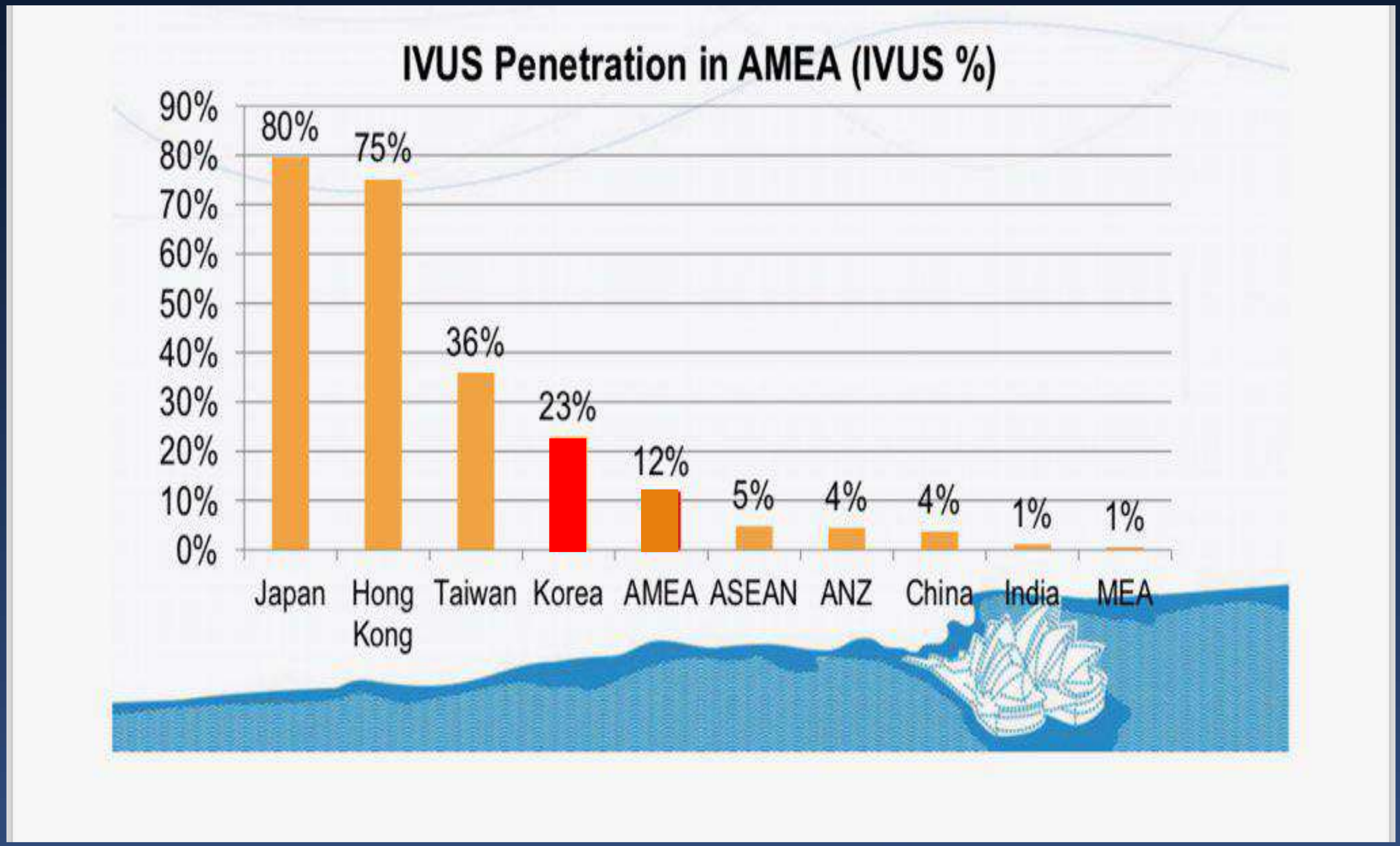
# Backgound

# How often do you use IVUS in daily practice?





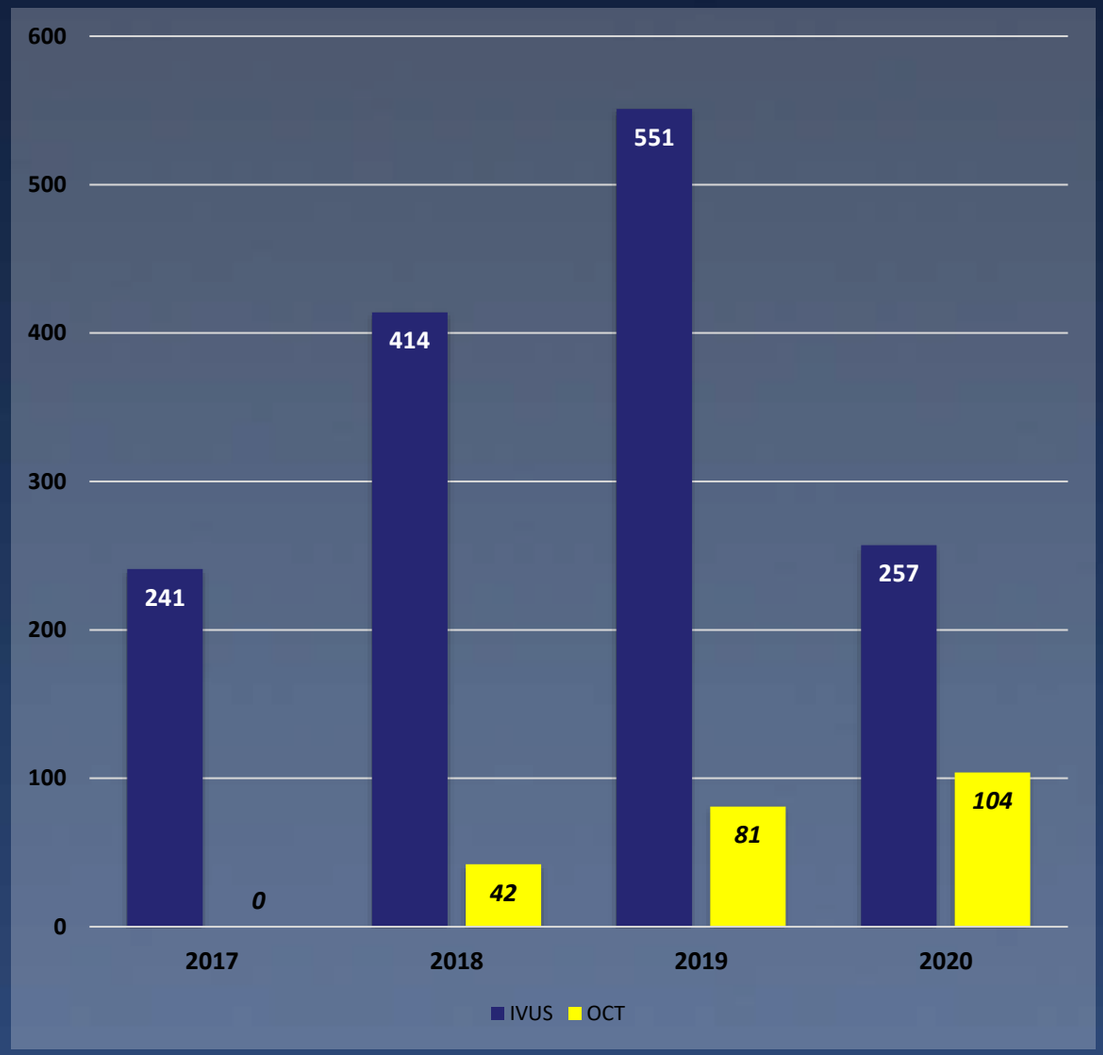
# IVUS penetration in some markets (2017)



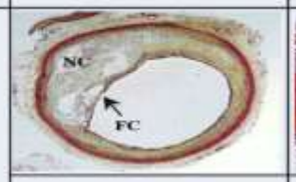
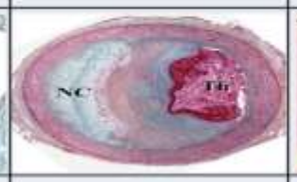
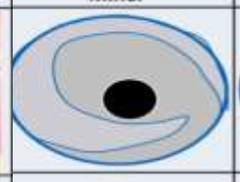
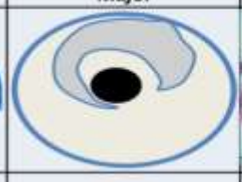
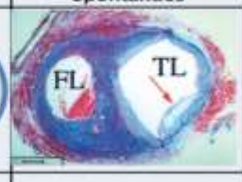
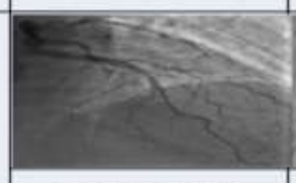
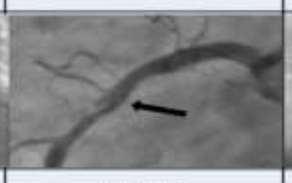
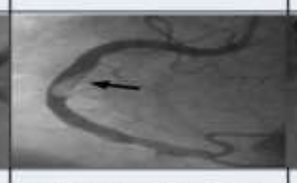
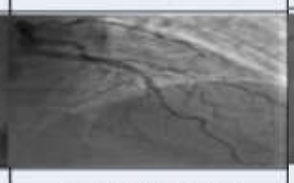
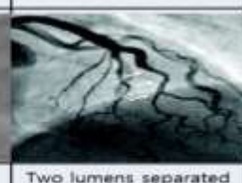
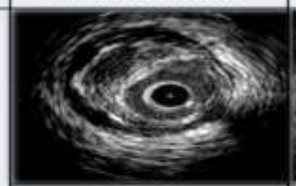
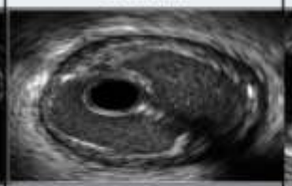
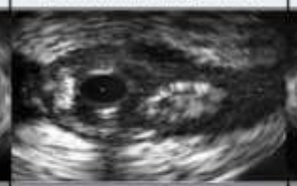
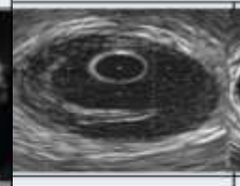
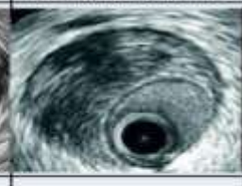
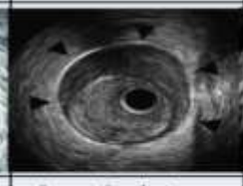
# Image Guided PCI

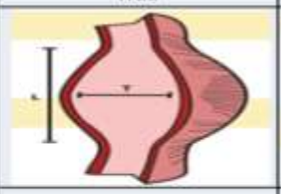
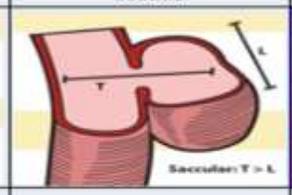
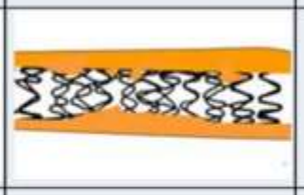
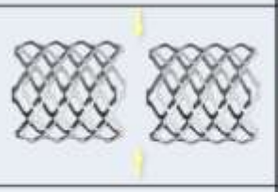
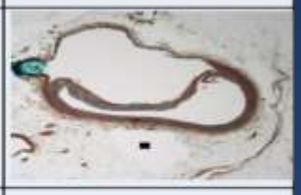
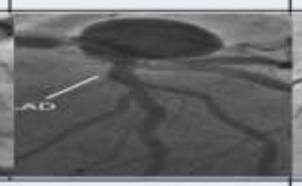
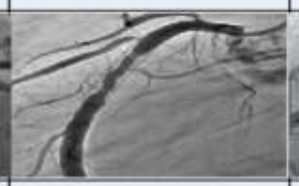
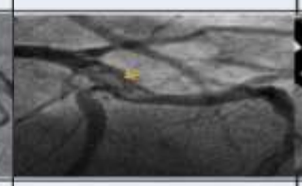
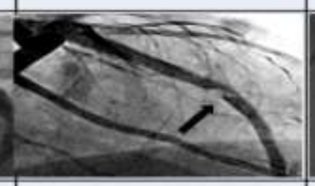
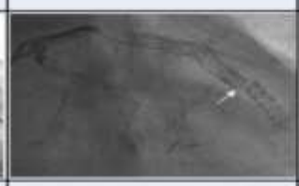
## Image Guided PCI


## IVUS & OCT

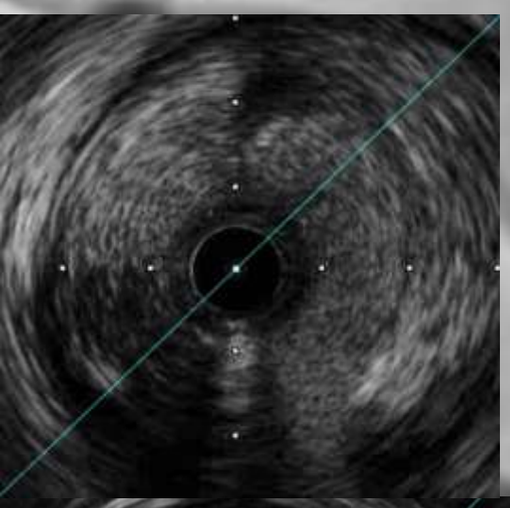


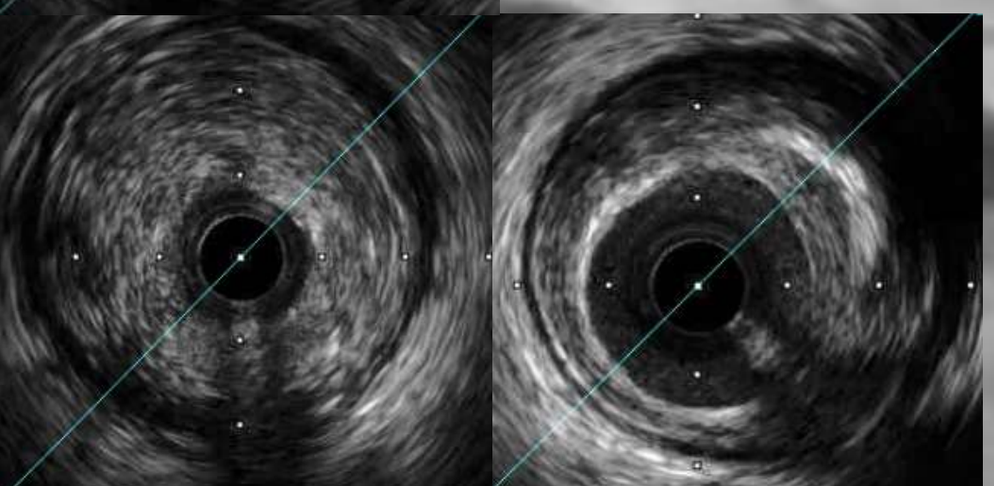
# ANGIO-IVUS definition

| | Unstable(Vulnerable) Plaque | Ruptured Plaque | Thrombosis | Atteuate Plaque | Dissection | | | Hematoma | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | Miner | Major | Spontanues | Intramural | Extramural |
| PATHOLOGY |  |  |  |  |  |  |  |  |  |
| ANGIO |  |  |  |  |  | |  |  |  |
| | Haziness & stenosis | Ulceration | Intraluminal filling defect | Haziness & stenosis | Radiolucent area | | Two lumens separated by a Radiolucent flap | Radiolucent area | Radiolucent area extra vascular |
| IVUS |  |  |  |  |  | |  |  |  |
| | Lipid core & Thin fibrous cap | Communication cavity | Intraluminal mobile mass | Fibrous with acoustic shadow | Non-flow-limiting or no lumen compromise | Flow-limiting or lumen compromise | Intramural hematoma | Separation between IEM and EEM typically crescent-shaped | Dissemination throughout an echogenic adventitia |
| Related | | | | | | | | | |

| | Aneurysm | | ISR | | Mall Apposition | Tissue Prolapse | Stent Fracture | True or False Lumen |
|---|---|---|---|---|---|---|---|---|
| | True | Pseudo | Neointimal Hyperplasia | NeoAtherosclerosis | | | | |
| PATHOLOGY |  |  |  |  |  |  |  |  |
| ANGIO |  |  |  |  |  |  |  |  |
| | blood-filled dilation (bulge) of a blood vessel | | Stenosis at instent or insegment | Almost same Vulnerable at instent or insegment | | | | |
| IVUS |  |  |  |  |  |  |  |  |
| | Wall had a 3layer appearance with intact adventitia | Monolayer wall with disrupted adventitia | Stable state instent | Unstable state instent | Incomplete stent apposition | Tend to project into the lumen | At least one stent blank site | 1. Three Layers appearance 2. Side Branch |
| Related | | | | | | | | |

# Image Guided PCI



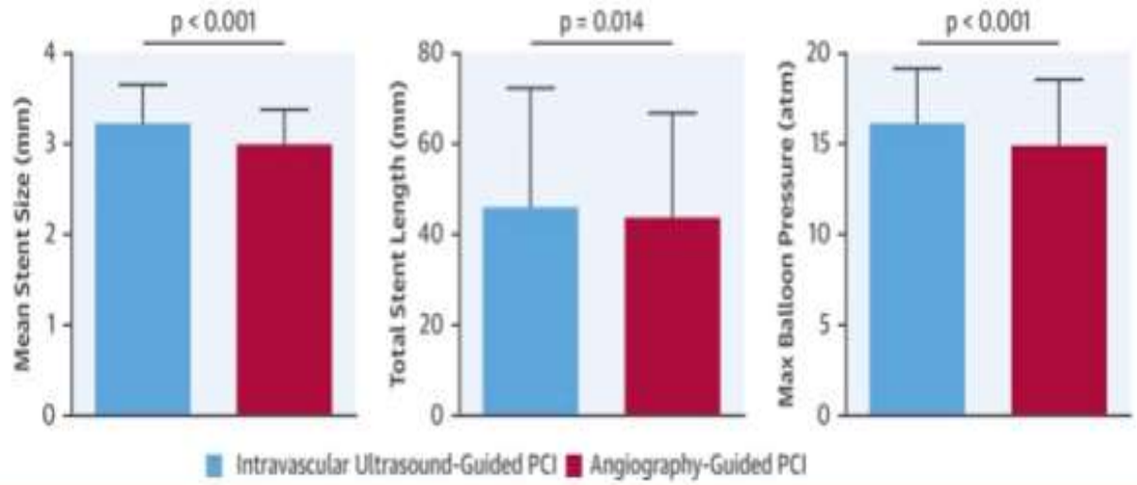


## Impact of Intravascular Ultrasound-Guided Percutaneous Coronary Intervention on Long-Term Clinical Outcomes in Patients Undergoing Complex Procedures

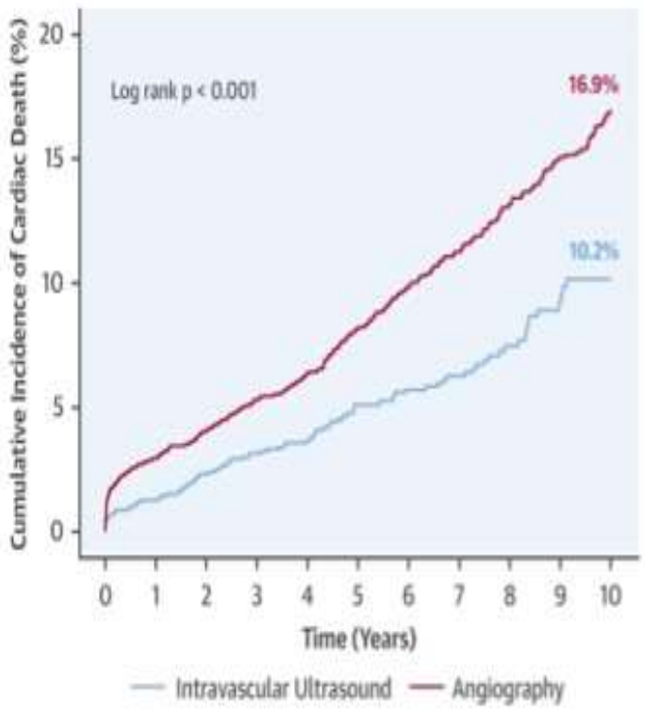
Ki Hong Choi MD [a], Young Bin Song MD, PhD [a,*], Joo Myung Lee MD, MPH, PhD [a], Sang Yoon Lee MD [a], Taek Kyu Park MD, PhD [a], Jeong Hoon Yang MD, PhD [a,b], Jin-Ho Choi MD, PhD [a,c], Seung-Hyuk Choi MD, PhD [a], Hyeon-Cheol Gwon MD, PhD [a], Joo-Yong Hahn MD, PhD [a,*]

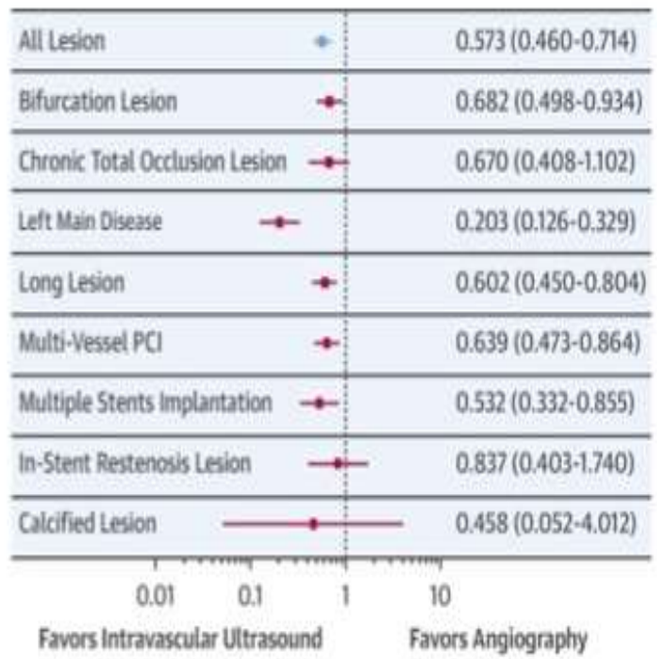
**CENTRAL ILLUSTRATION: Long-Term Clinical Outcomes Between IVUS-Guided and Angiography-Guided PCI for Complex Lesion**

### Procedural Factors




### Clinical Outcomes

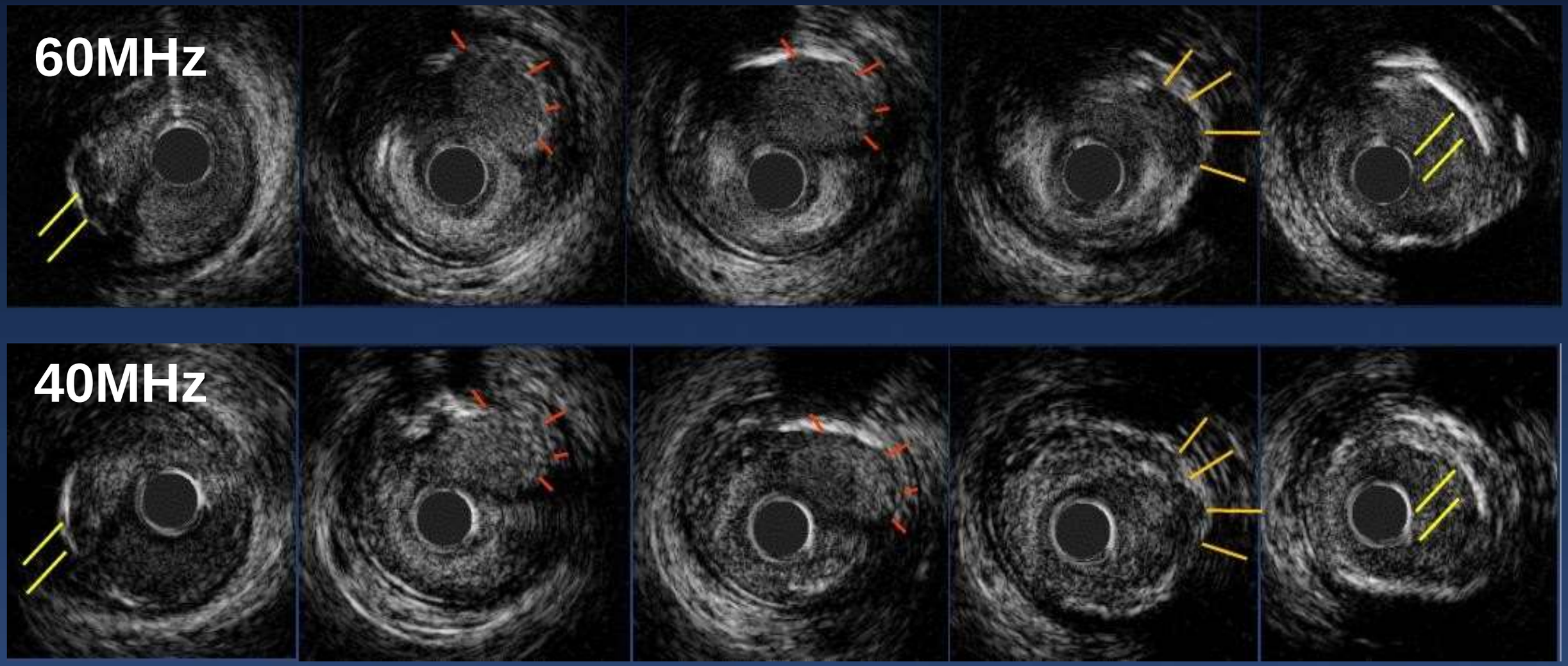



Choi, K.H. et al. J Am Coll Cardiol Intv. 2019;12(7):607-20.

# Image Guided PCI HD IVUS

## Difference between 60 and 40 MHz

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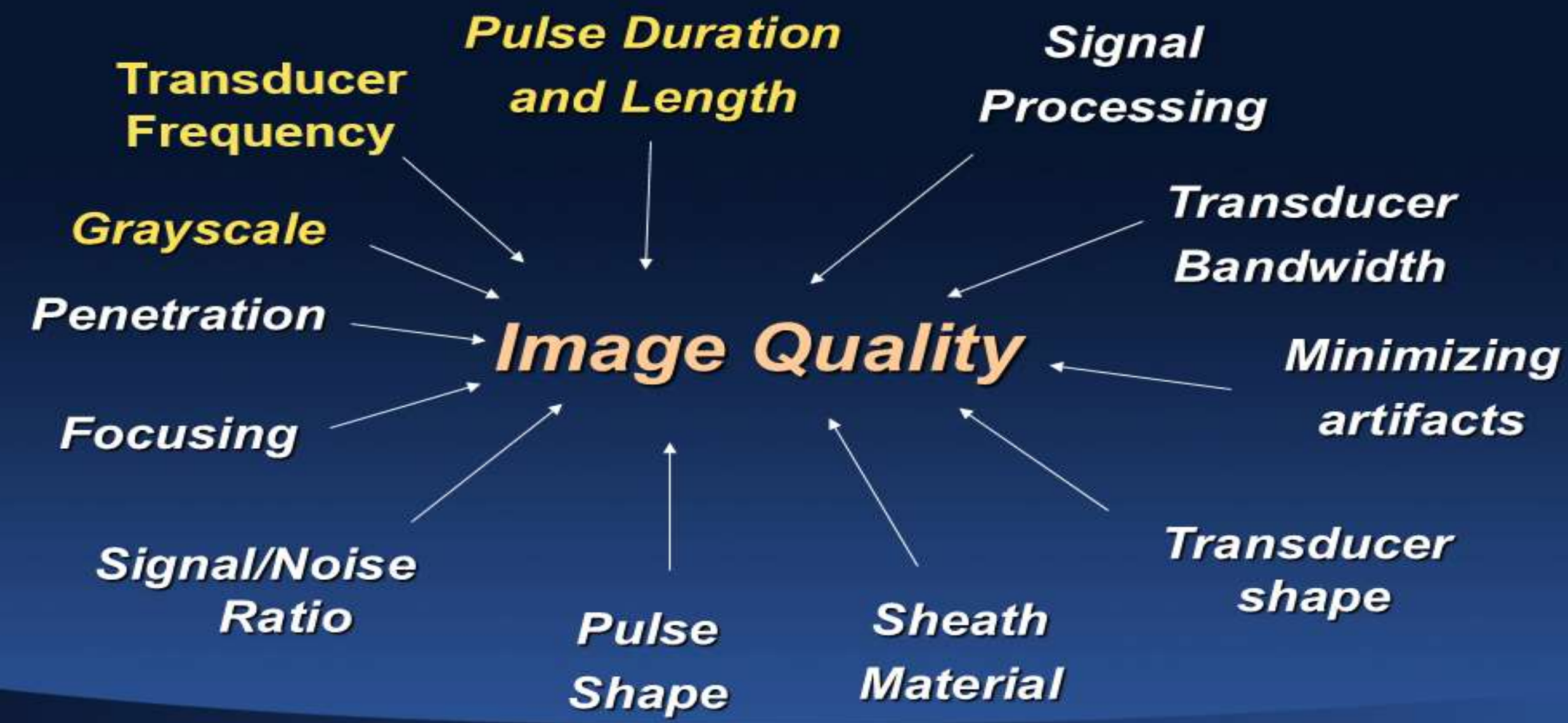
# What determines image quality?



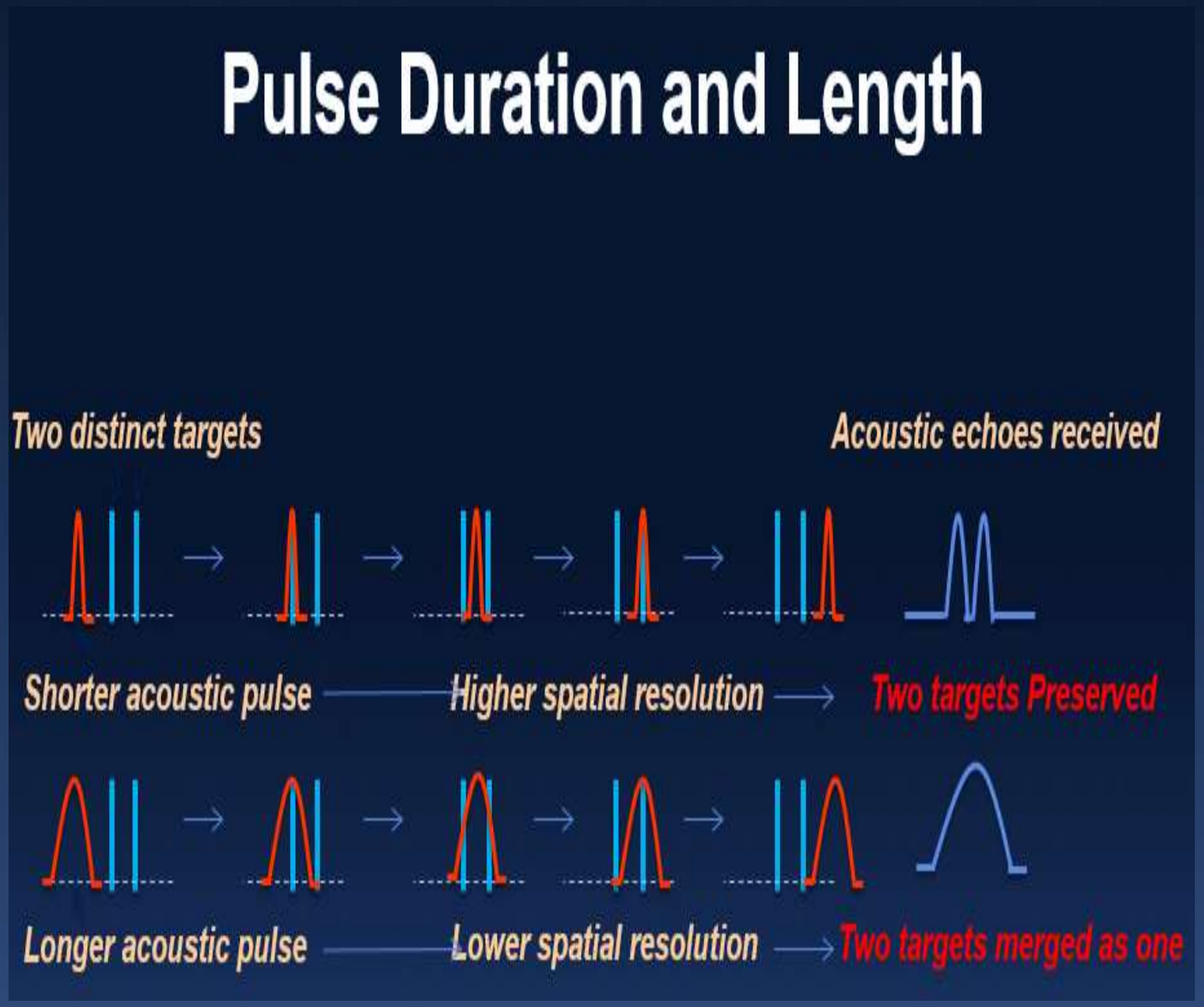
# What determines image quality?

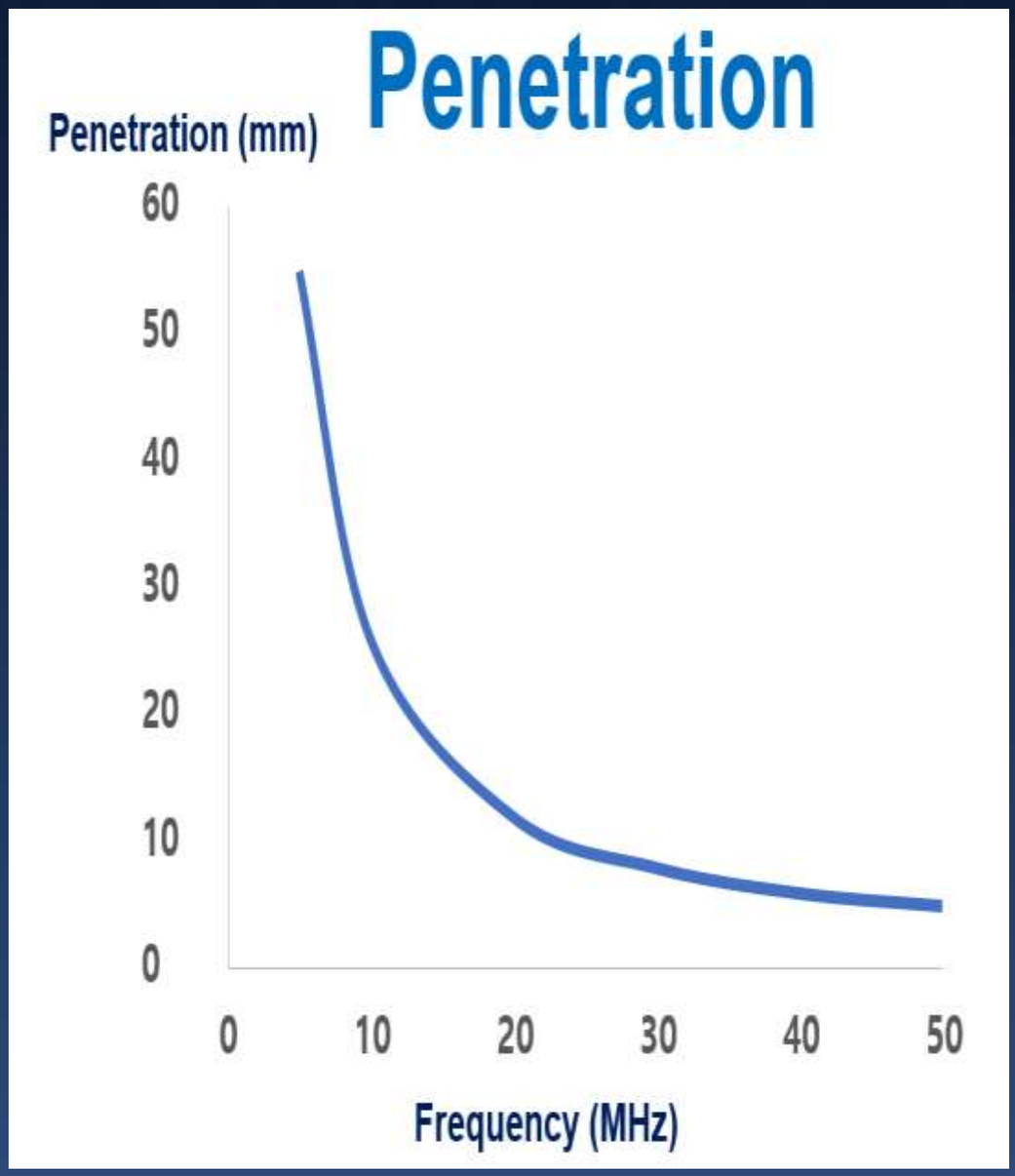
## Transducer Frequency

| ←Low Frequency | | High Frequency→ |
|---|---|---|
| **Signal Penetration Depth** | *EEM, vessel borders, positive remodeling* | |
| + See deeply into vessel tissue | | Shallow depth-of-field - |
| **Lumen Visibility** | *lumen darkness, differentiation of blood speckle from tissue* | |
| + Low blood speckle, easy to identify lumen | | High blood speckle, less clear lumen borders - |
| **Imaging Resolution** | *dissection, thrombus, rupture, etc.* | |
| - Low resolution, can't distinguish small structures | | Crisp detail of small structures + |
| **Tissue Visibility** | *plaque layering, density of vessel tissue, etc.* | |
| - Unable to differentiate tissue | | Tissue variations evident + |

# What determines image quality?

## Pulse Duration and Length

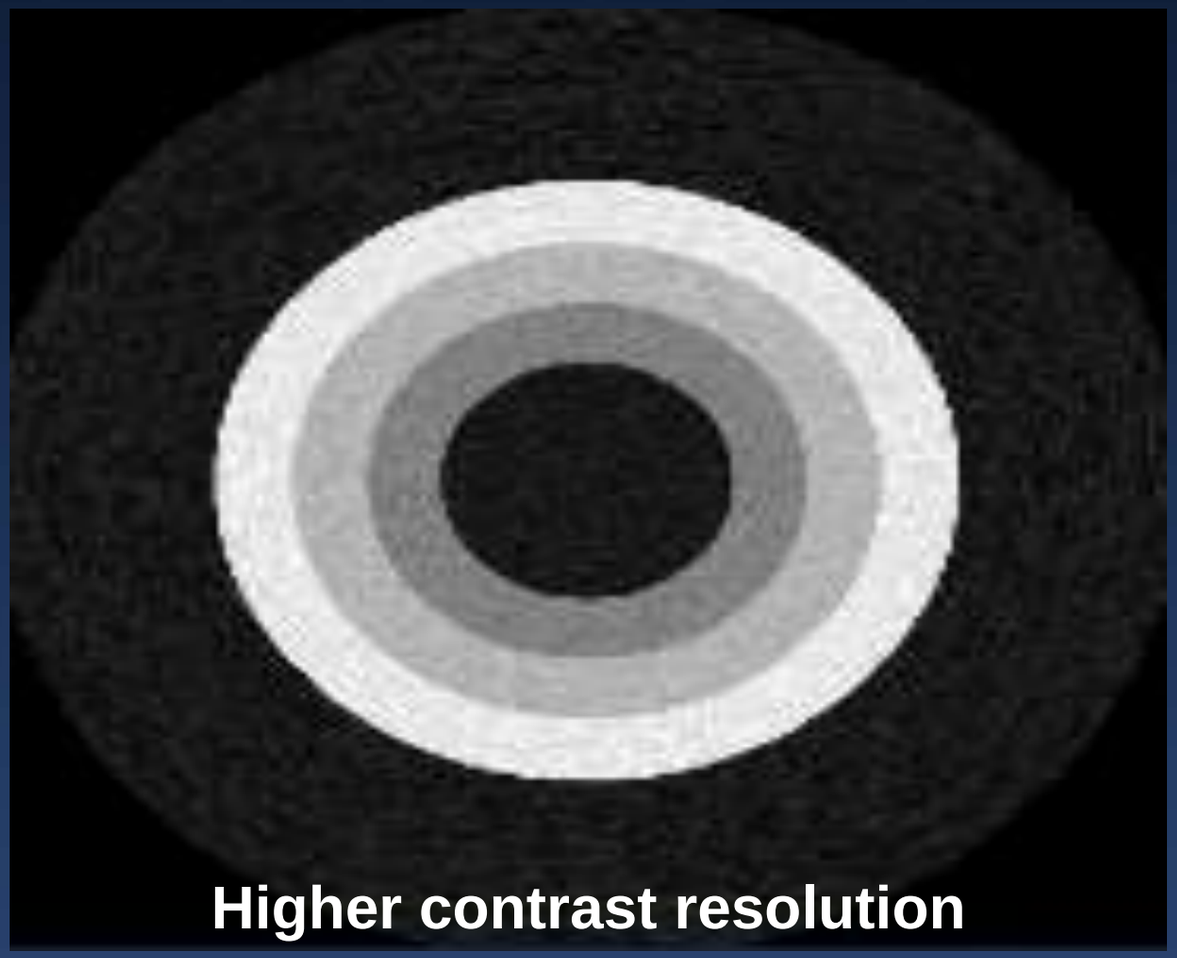


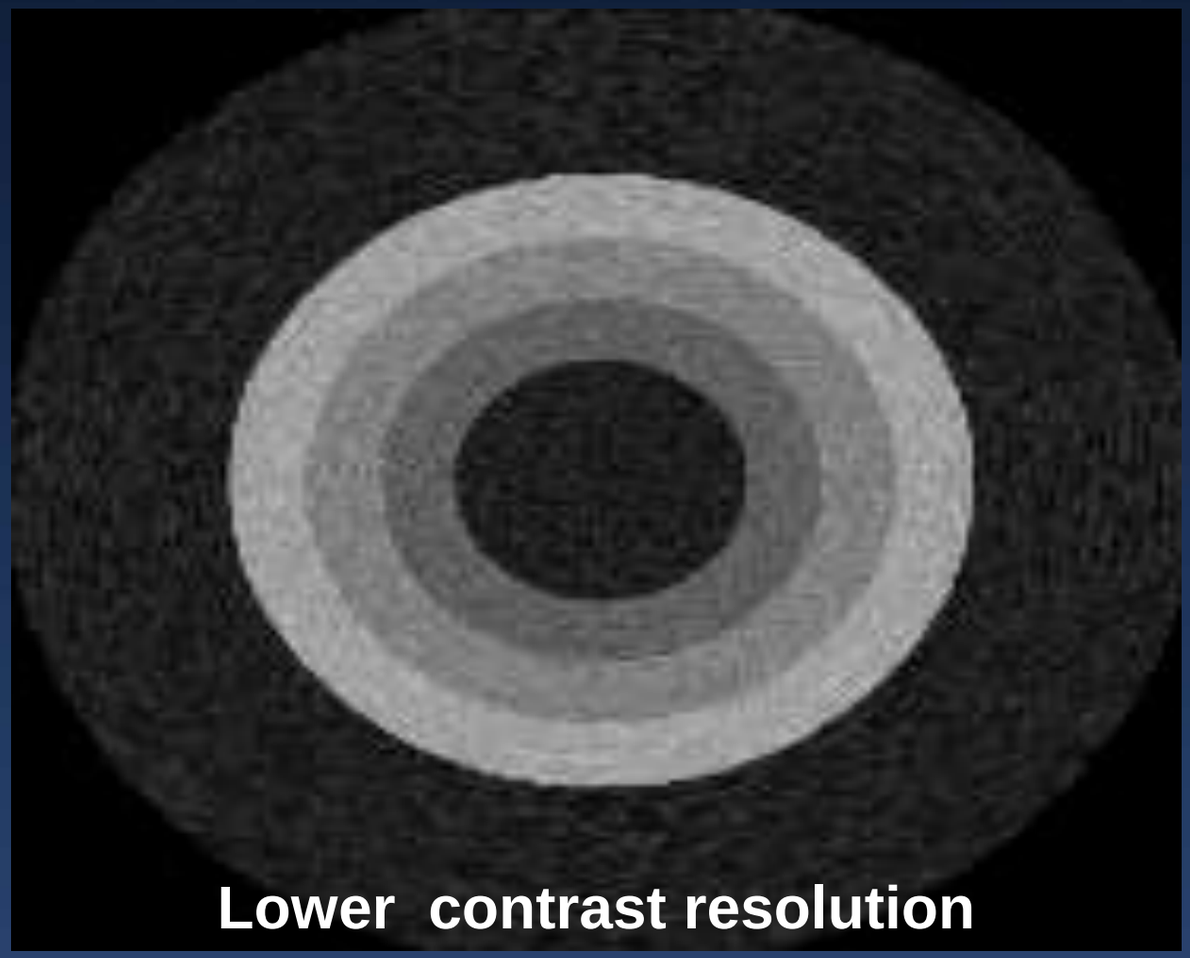

To test Axial Resolution: Look for stent strut thickening
To test Lateral Resolution: Look for stent strut separation

# What determines image quality?

## Contrast Resolution



Higher contrast resolution



Lower  contrast resolution

*Lower contrast resolution*
*Blurred boundary*
*Visible noise*
*Dimness of overall image*

# HD IVUS

## HD-IVUS Imaging System Comparison

| | ACIST HDi / Kodama | Boston Scientific | Volcano FACT | InfraReDx | St. Jude OCT |
|---|---|---|---|---|---|
| Frequency or Wavelength | 60 MHz | 60 MHz | Not available | 50 MHz | 1.3 um |
| Nature of the Energy | Ultrasound | | | | Optical |
| Axial Resolution | 40 μm | 22 μm | <50 μm | 20 μm | 15 μm |
| Lateral Resolution | 90 μm | 50-140 μm | 100-200 μm | <200 μm | 40 μm |
| Soft Tissue Penetration | >2.5 mm | >3.5 mm | | | 0.8-1.2 mm |
| Blood Penetration | >3.4 mm | >4.0 mm | | | ≤1.2 mm |
| Pullback Speed (mm/s) | 0.5, 1.0, 2.5, 5.0, 10 | 0.5, 1.0 | | 0.5 | 20 |
| Pullback Length (mm) | 130 | 100 | | 150 | 75 |

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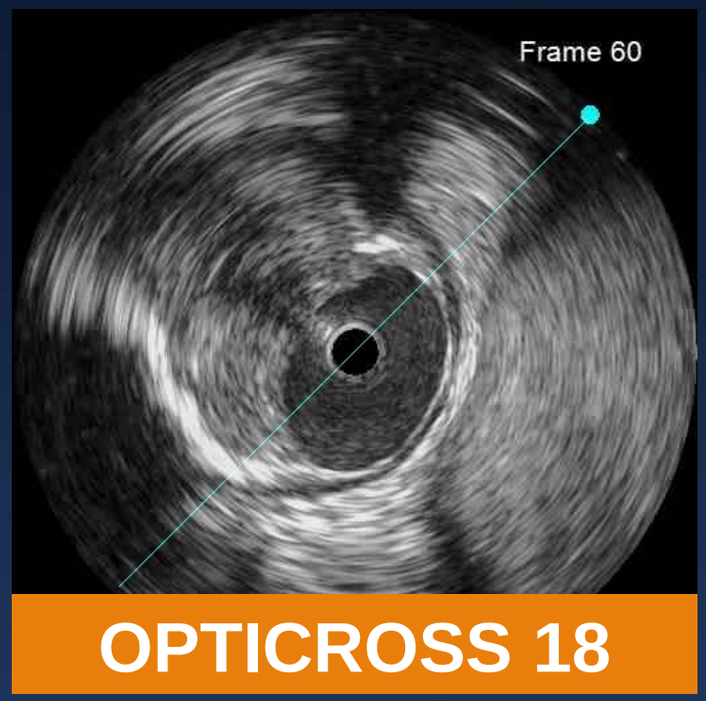
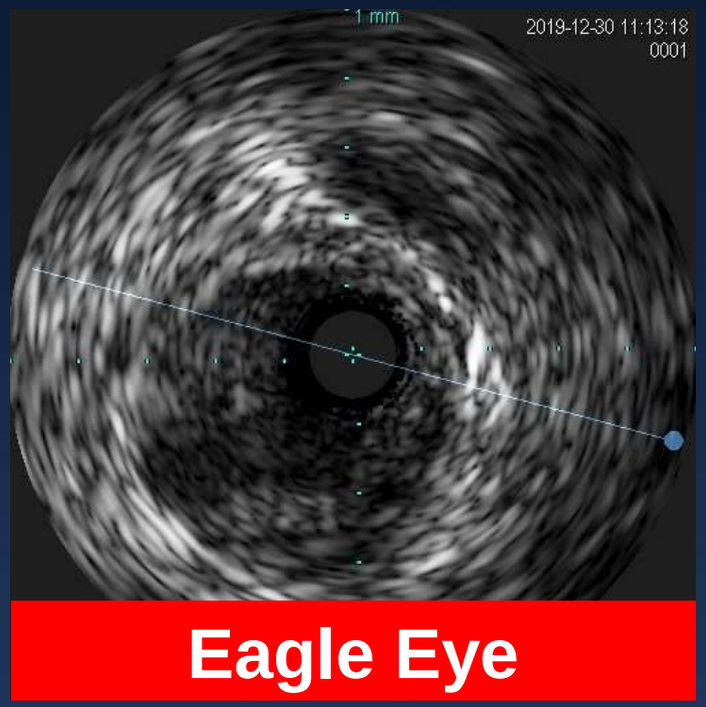
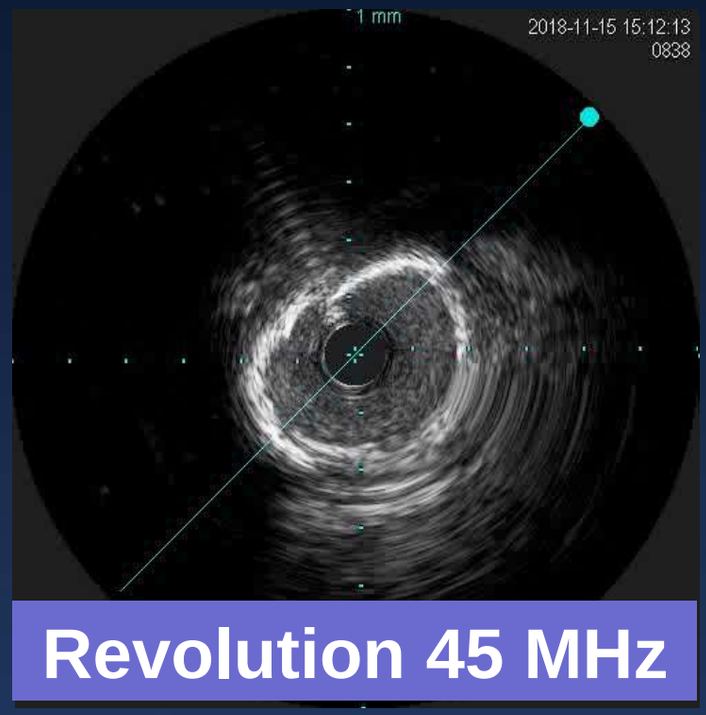
# Various IVUS Image



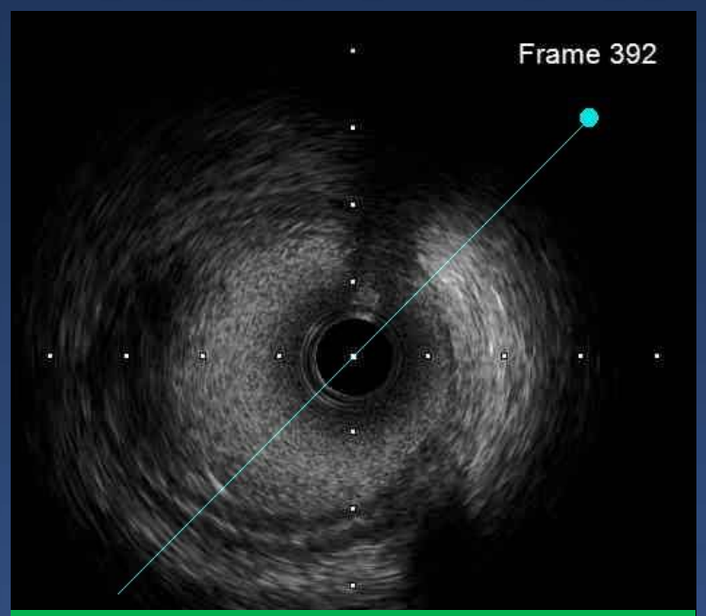

OPTICROSS 18



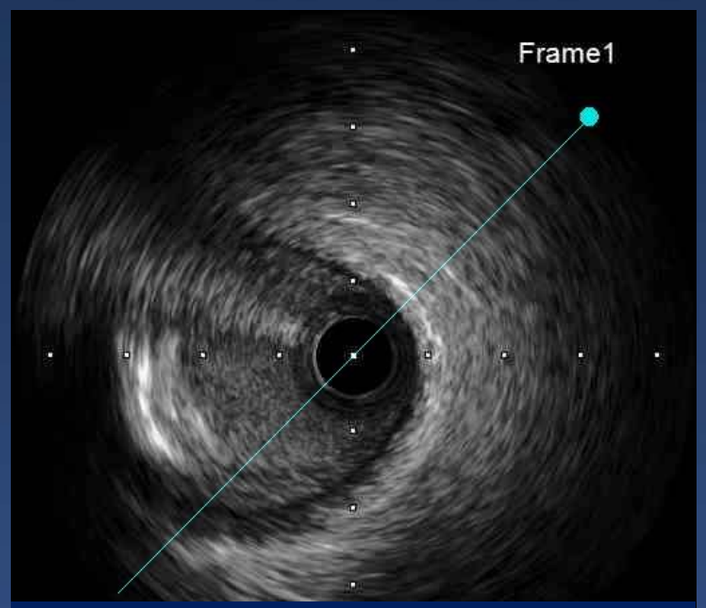

Eagle Eye




Revolution 45 MHz




OPTICROSS HD




OPTICROSS

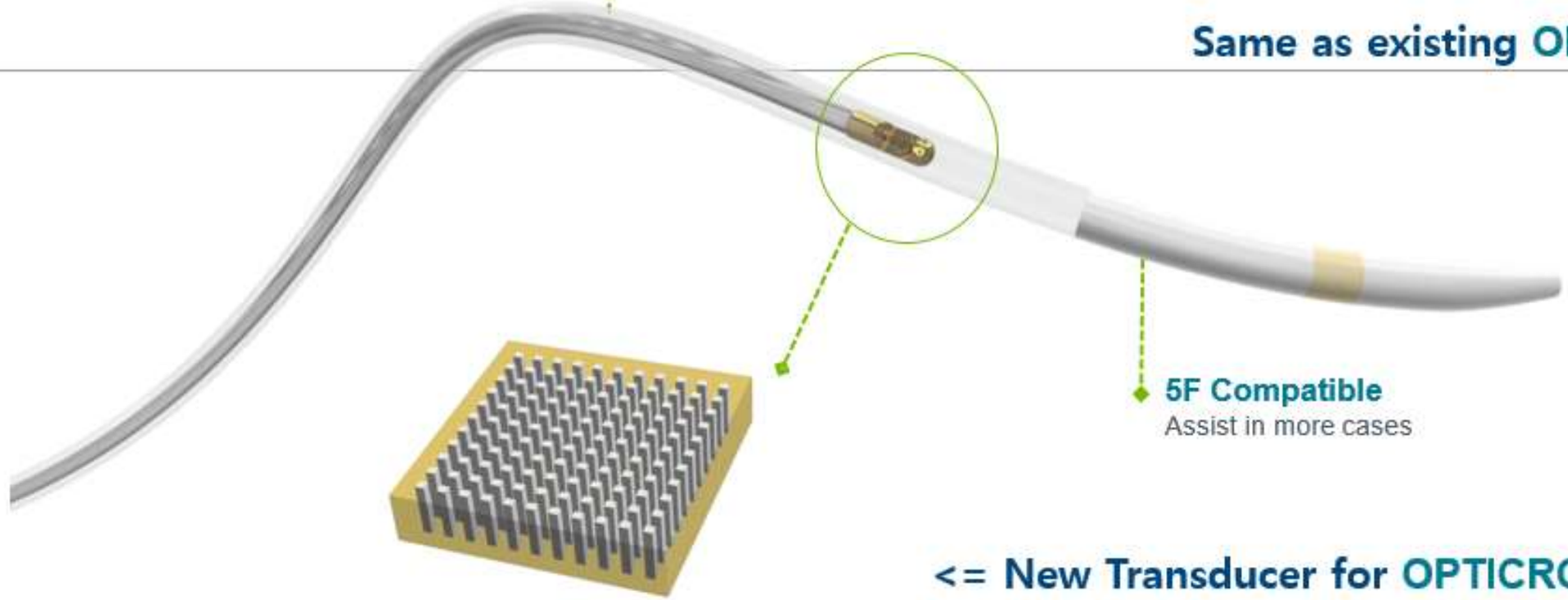
# BSC HD IVUS

## OPTICROSS™ HD Features and Benefits

Boston Scientific
Advancing science for life™

**Exceptional Deliverability**
Well-balanced engineering design

**Same as existing OPTICROSS™**



**5F Compatible**
Assist in more cases

**<= New Transducer for OPTICROSS™ HD**

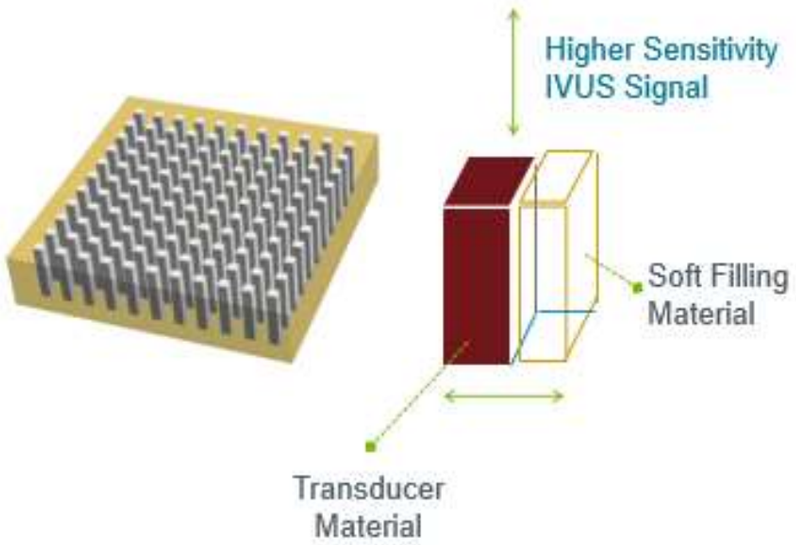
**Advanced 60 MHz Composite Transducer**
Precise image with 6 mm depth for small to large vessel assessment

# BSC HD IVUS

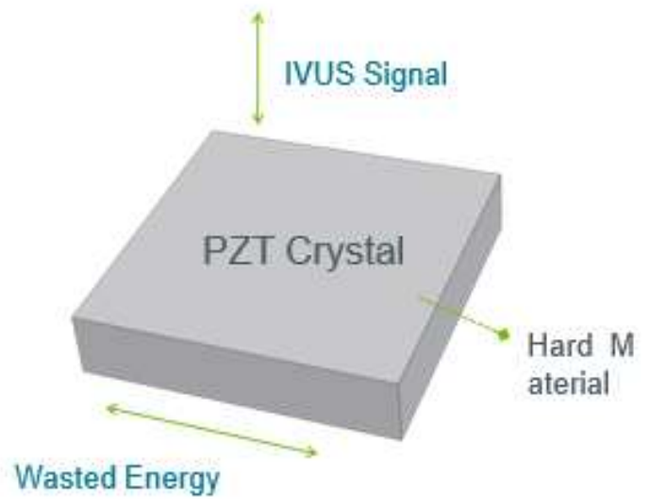
## Advanced 60 MHz Composite Transducer

Boston Scientific
Advancing science for life™

### Advanced Composite Transducer
of OPTICROSS™ HD 60 MHz Imaging Catheter




### Conventional PZT Transducer
of OPTICROSS 40 MHz Imaging Catheter




- The Advanced 60 MHz Composite Transducer provides higher IVUS signal sensitivity than conventional design, and more balanced acoustic coupling between catheter and tissue.
- This results in 60 MHz central frequency with wider bandwidth for significant improvement in axial and lateral image resolution.

# BSC HD IVUS

## Advanced 60 MHz Composite Transducer

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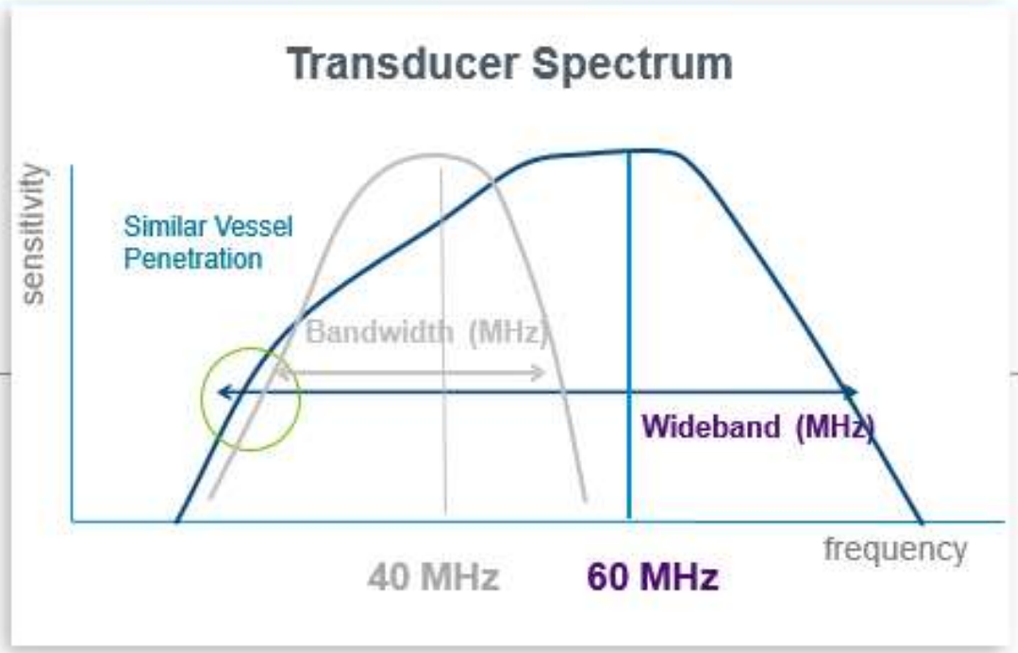
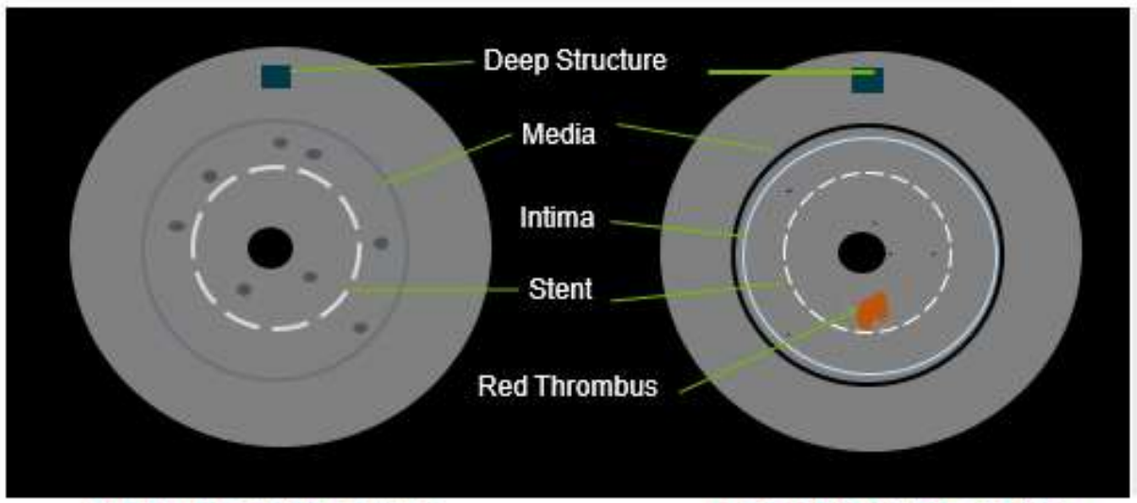



The wideband spectrum of the Advanced 60 MHz Composite Transducer provides more information from tissue and better visualization of fine structures

OPTICROSS™ HD Imaging Catheter
OPTICROSS Imaging Catheter

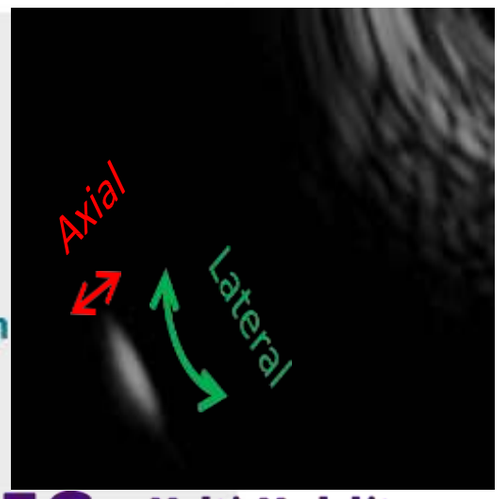



**OPTICROSS™ 40 MHz** Imaging Catheter

**OPTICROSS HD 60 MHz** Imaging Catheter

**Better Image Resolution**
- Clearer Arterial Structures

**Similar Vessel Penetration**



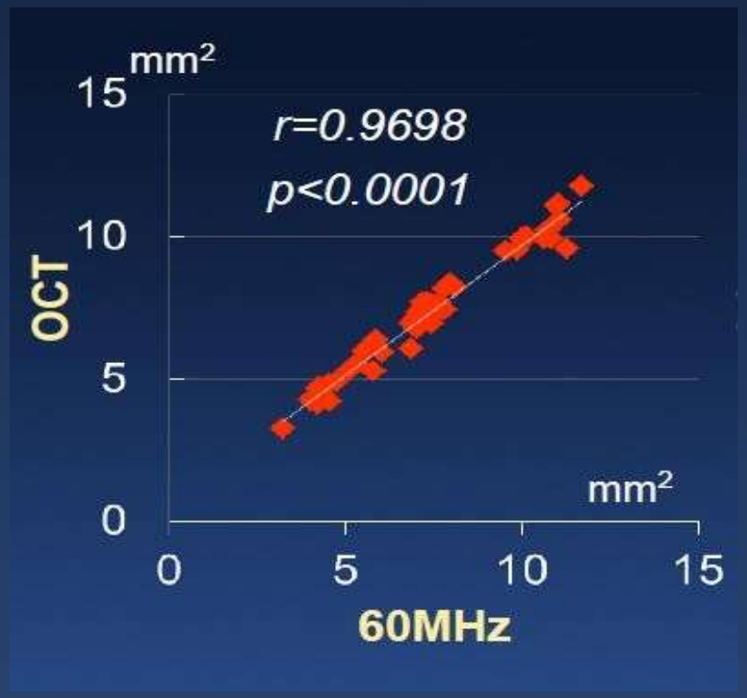

**POLARIS** Multi-Modality Guidance System

# 40MHz and 60MHz IVUS and OCT

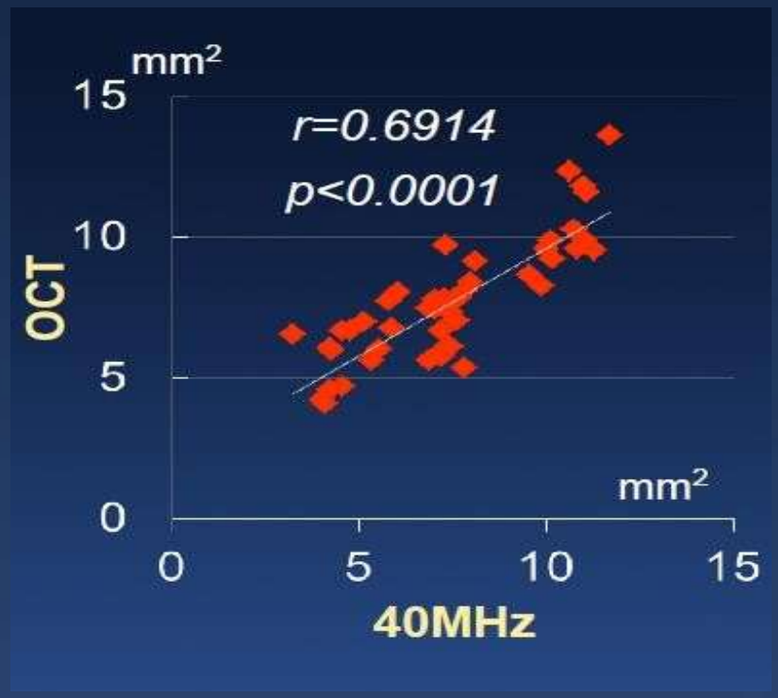
## In Vitro Correlation of Lumen Area Among 40 MHz and 60 MHz IVUS and OCT

(50 matched x-sections from 9 arteries)

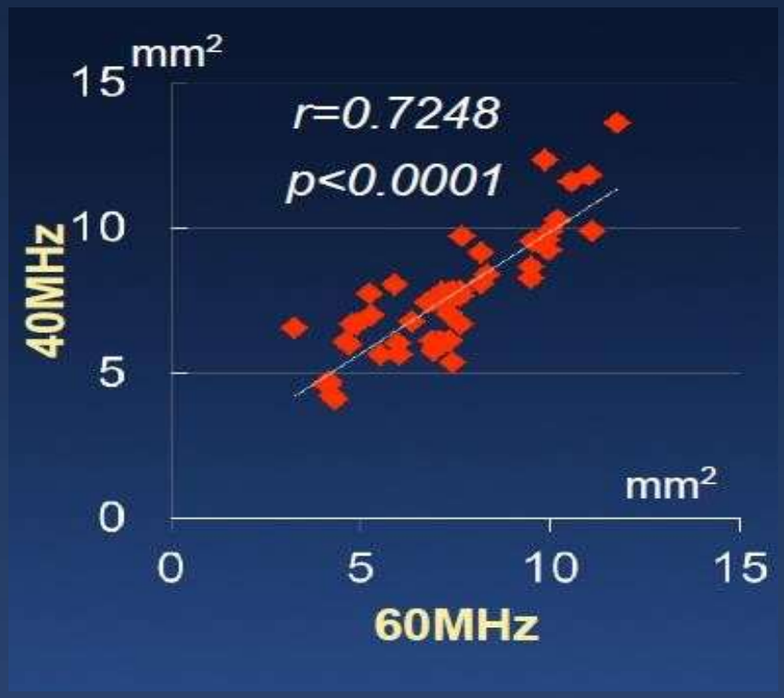
*60MHz vs OCT*




*40MHz vs OCT*



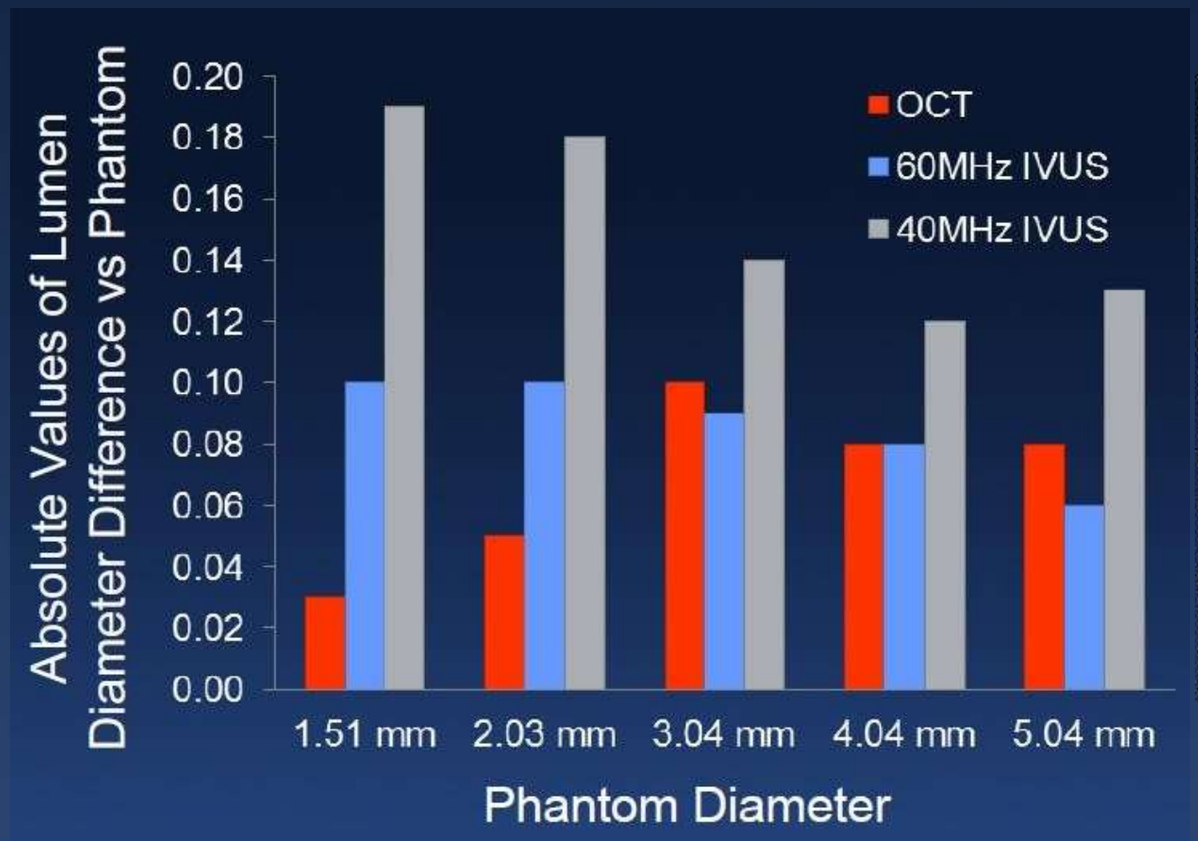

*60MHz vs 40MHz*




TCT 2014

# 40MHz and 60MHz IVUS and OCT

**Five coronary phantoms with known lumen diameters of 1.51, 2.03, 3.04, 4.04, and 5.04 mm were imaged in a saline-filled tank at 37℃.**

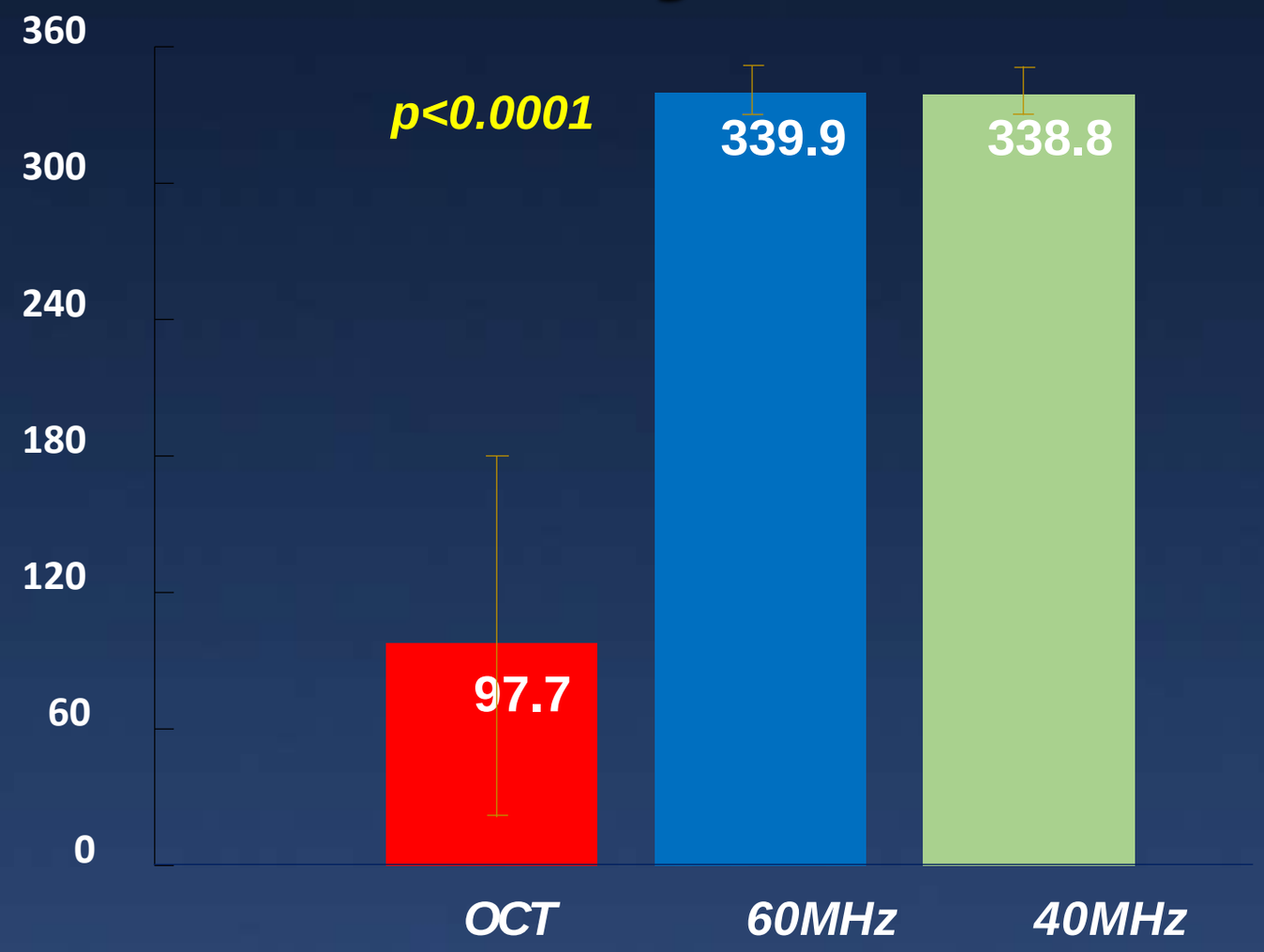



| Modality | Mean Lumen Diameter Difference vs Phantom |
|---|---|
| OCT | .0.07 ± 0.03mm |
| 60MHz IVUS | .0.08 ± 0.03mm |
| 40MHz IVUS | .0.15 ± 0.03mm |

TCT 2014

# 40MHz and 60MHz IVUS and OCT

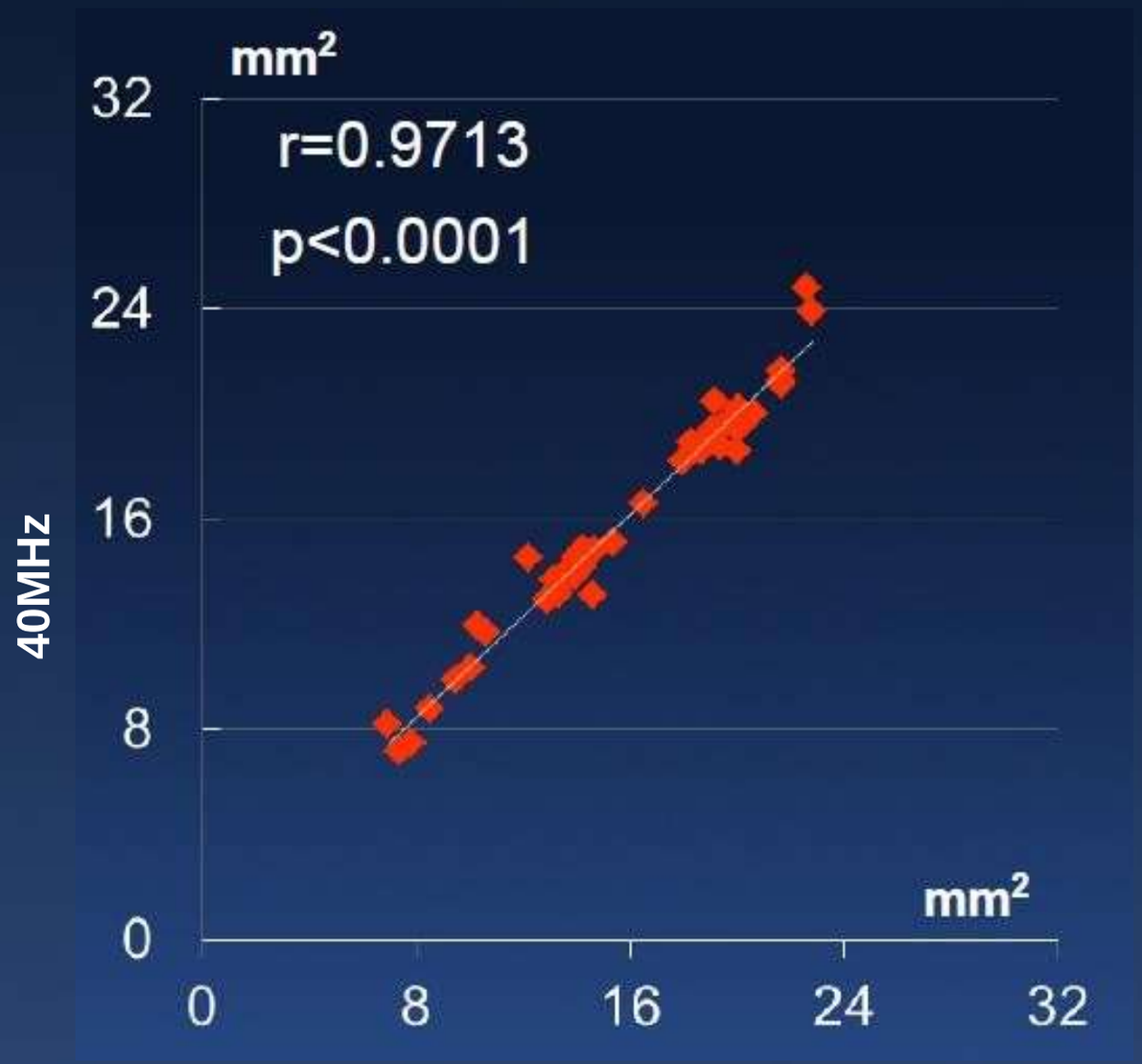
## Visibility of EEM



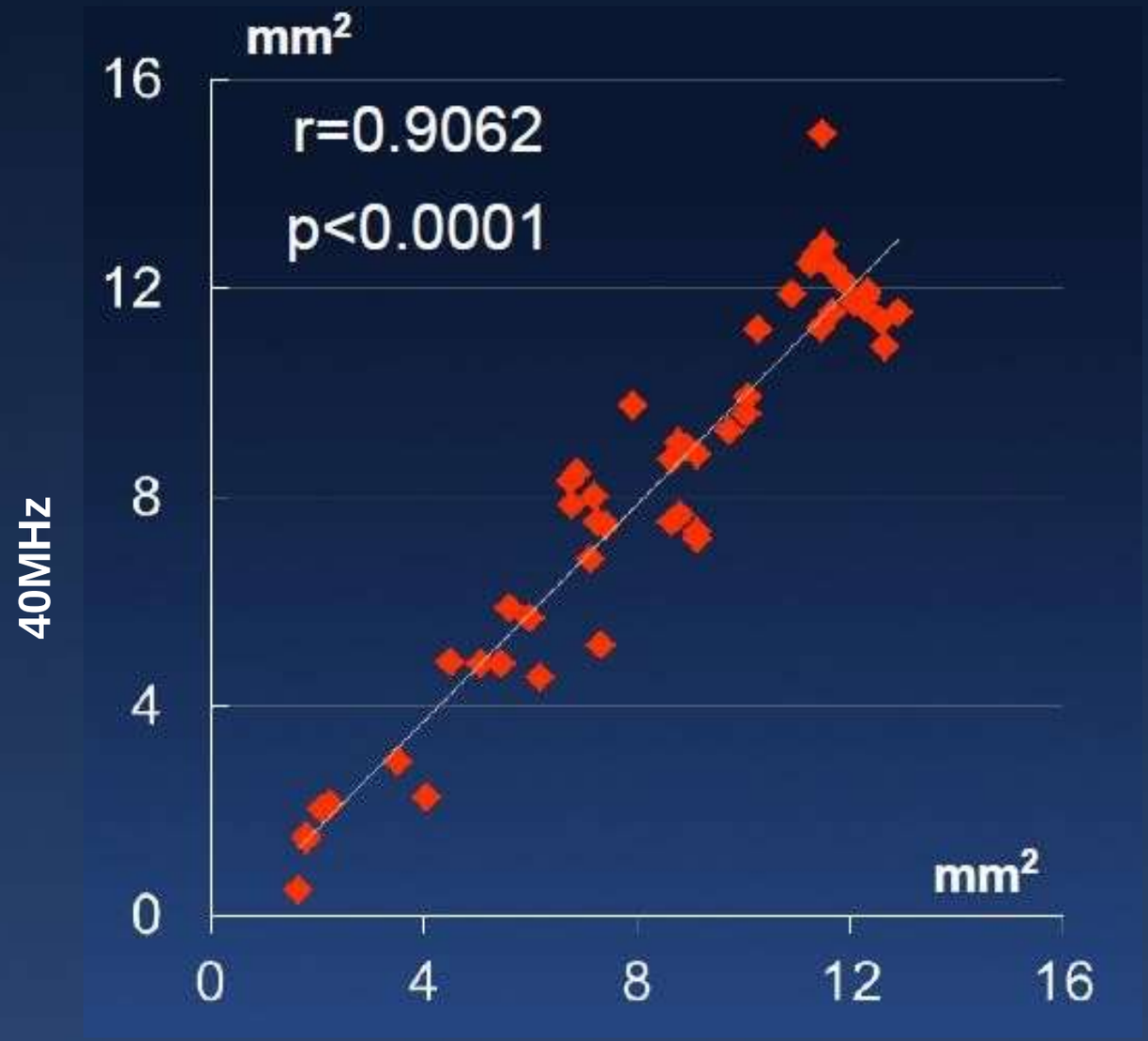

*Honda et al. ACC 2013*

# 40MHz and 60MHz IVUS

**EEM Area**




**Plaque Area**




*Honda et al. ACC 2013*

# BSC HD IVUS

## Image Comparison

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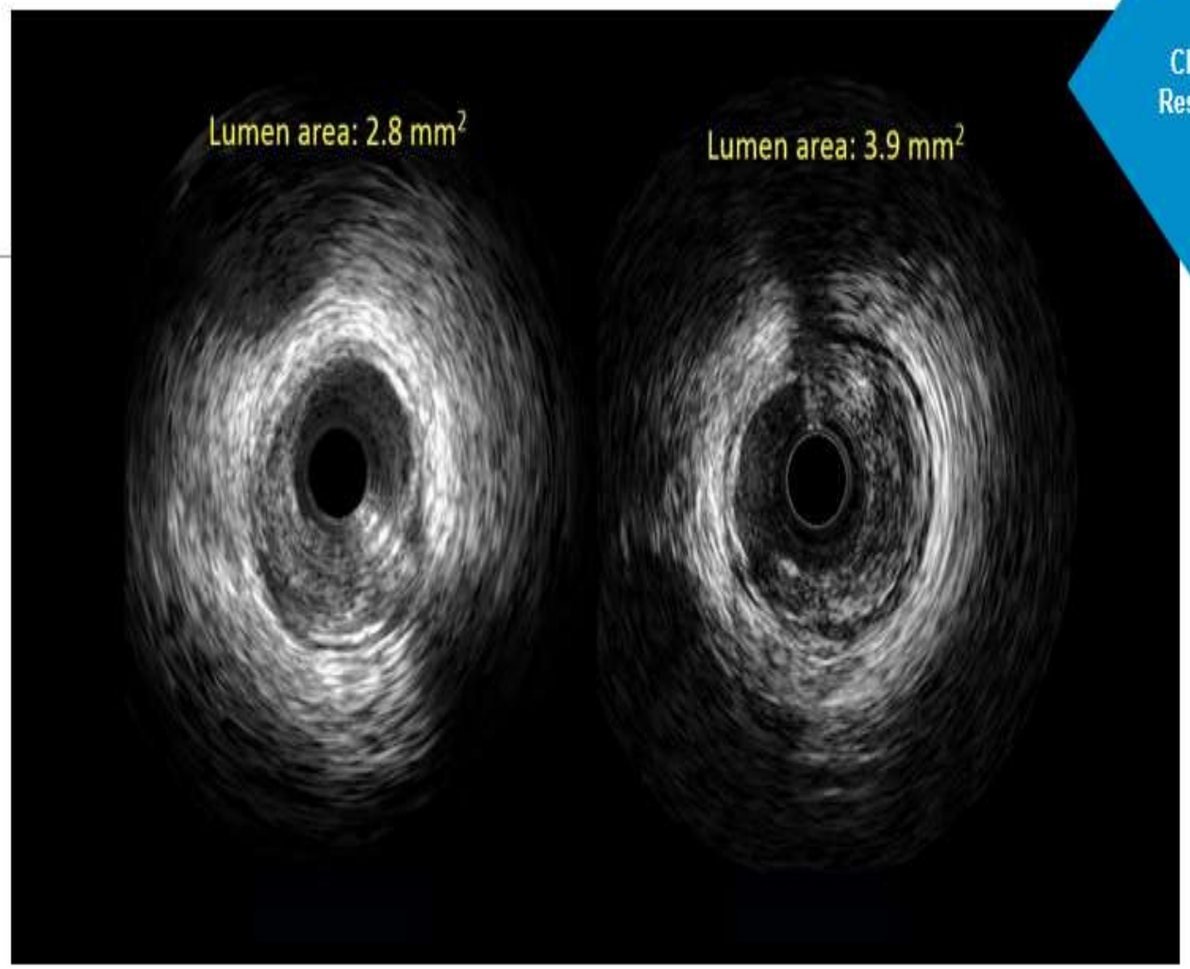
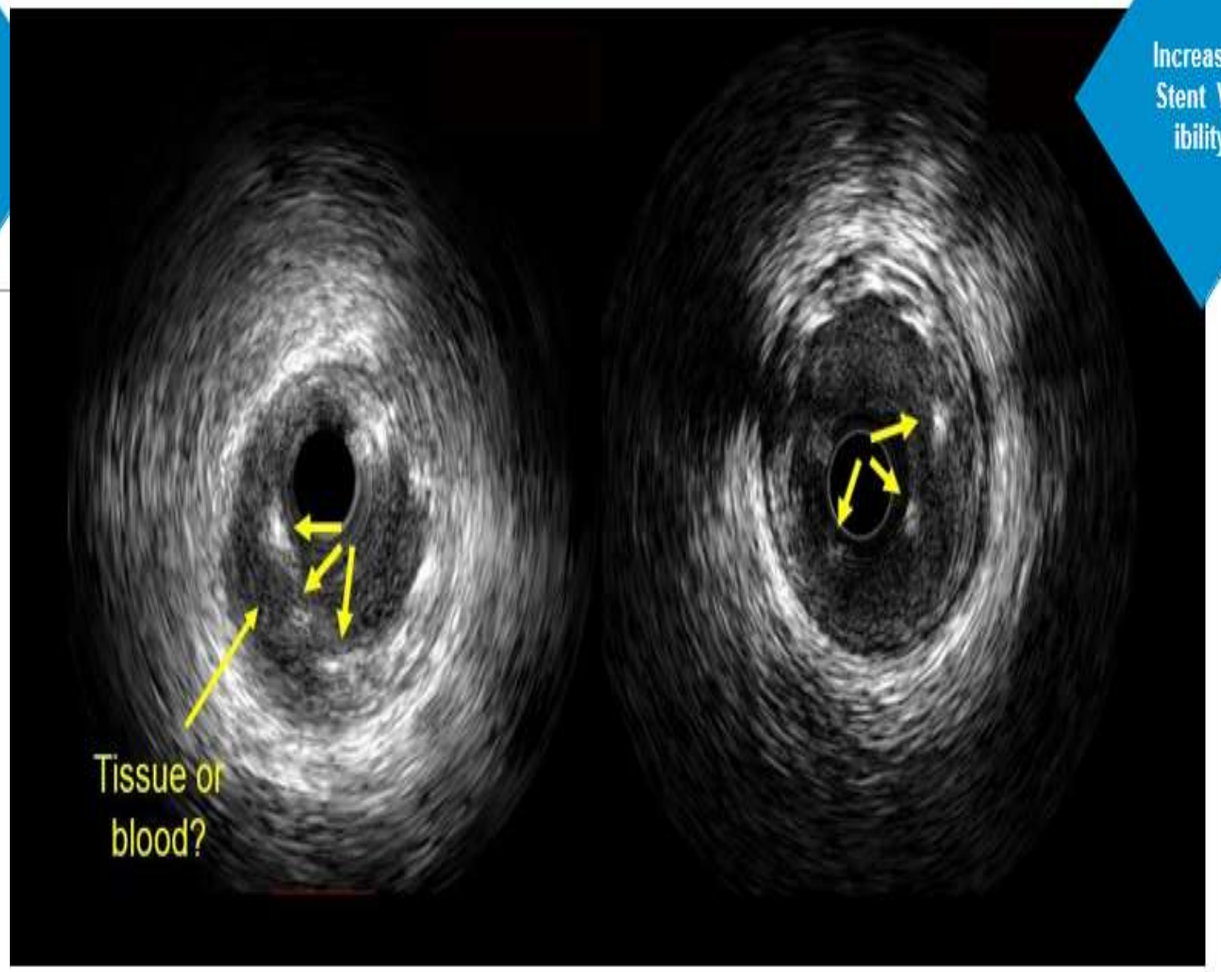



OPTICROSS™
Imaging Catheter
40 MHz

OPTICROSS™ HD
Imaging Catheter
60 MHz




OPTICROSS™
Imaging Catheter
40 MHz

OPTICROSS™ HD
Imaging Catheter
60 MHz

# BSC HD IVUS

## OPTICROSS™ HD 60 MHz Image Examples

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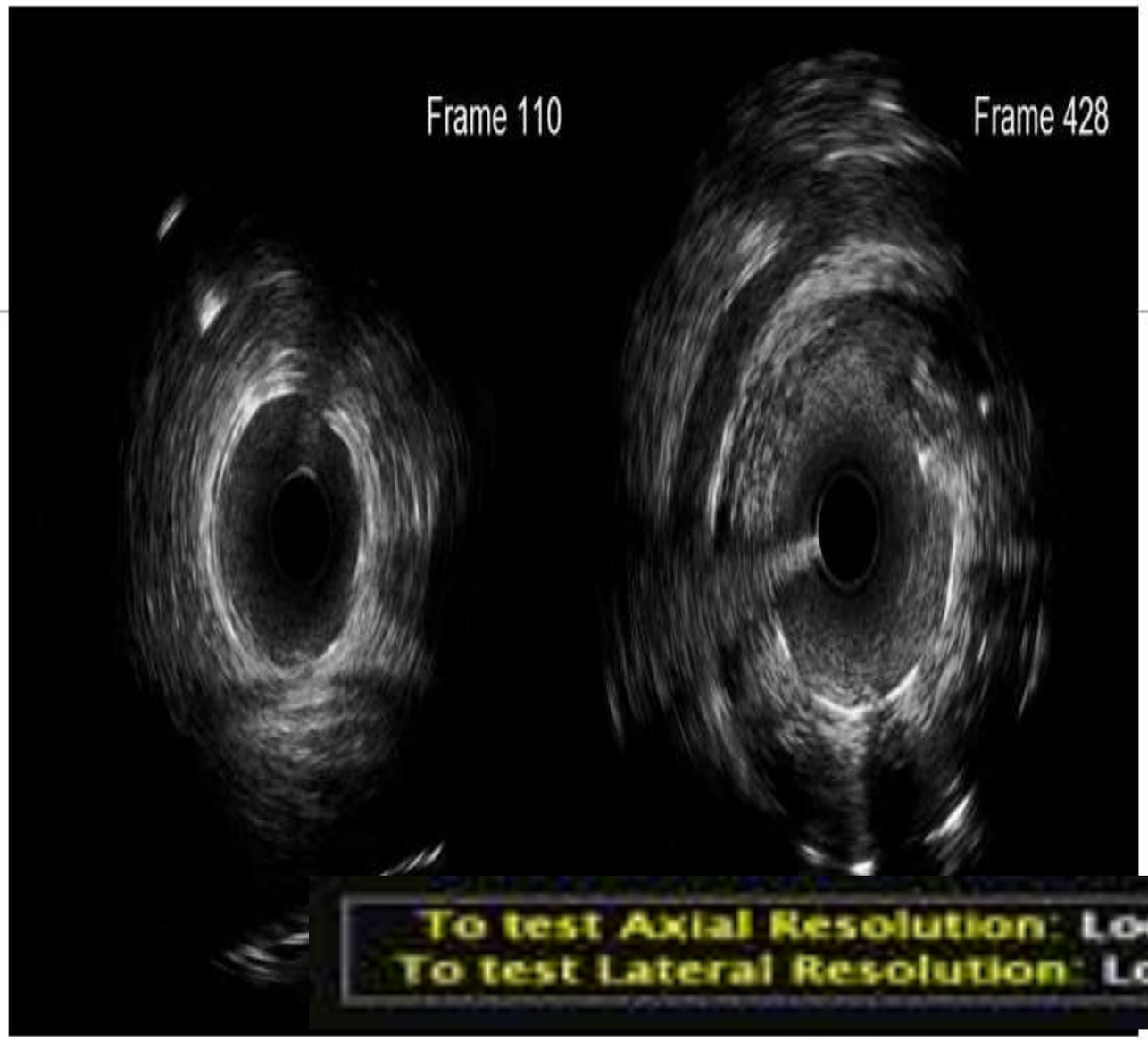
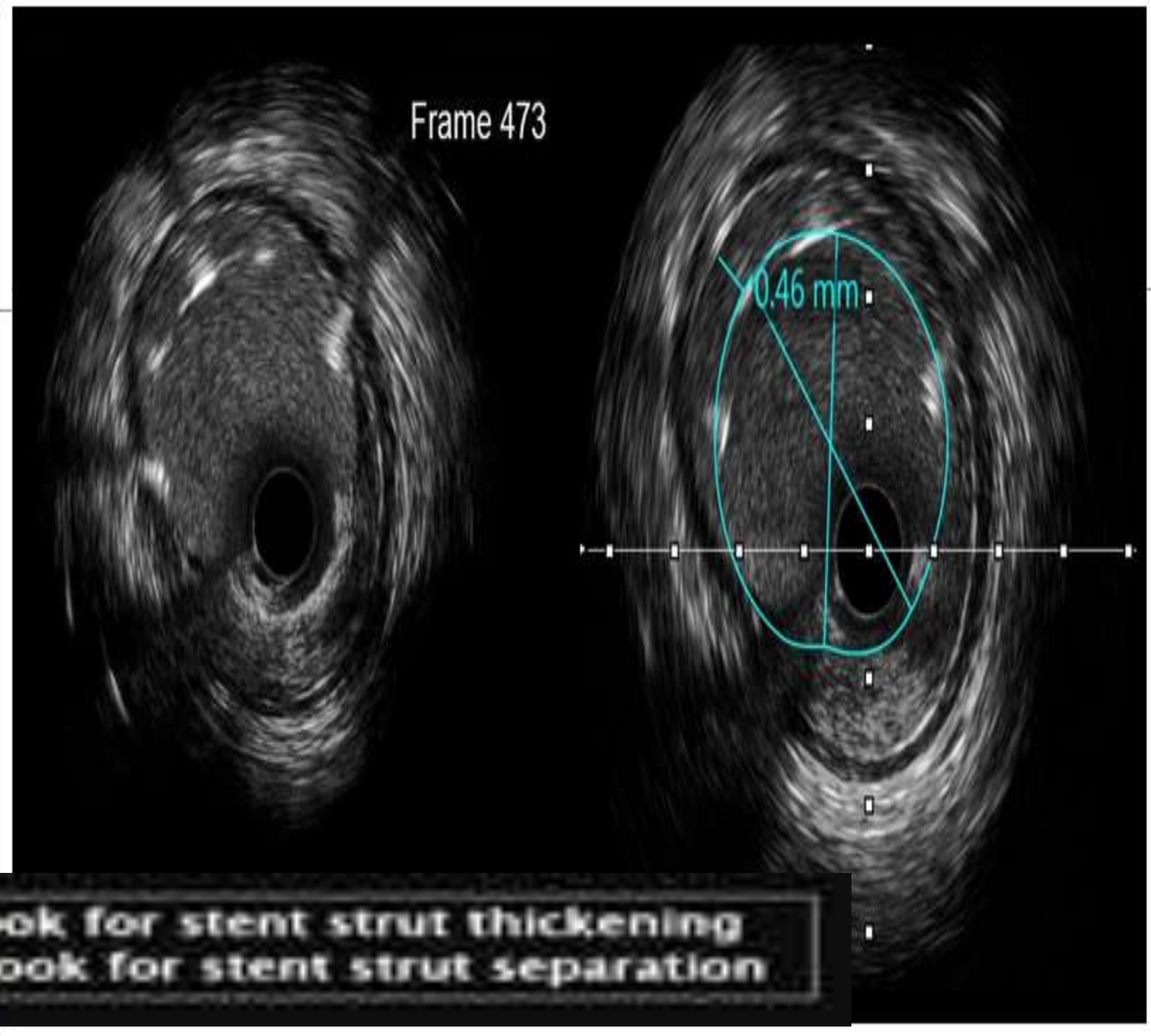



Stent




Two Stents

Malapposed Stent

# BSC HD IVUS

## OPTICROSS™ HD 60 MHz Image Examples

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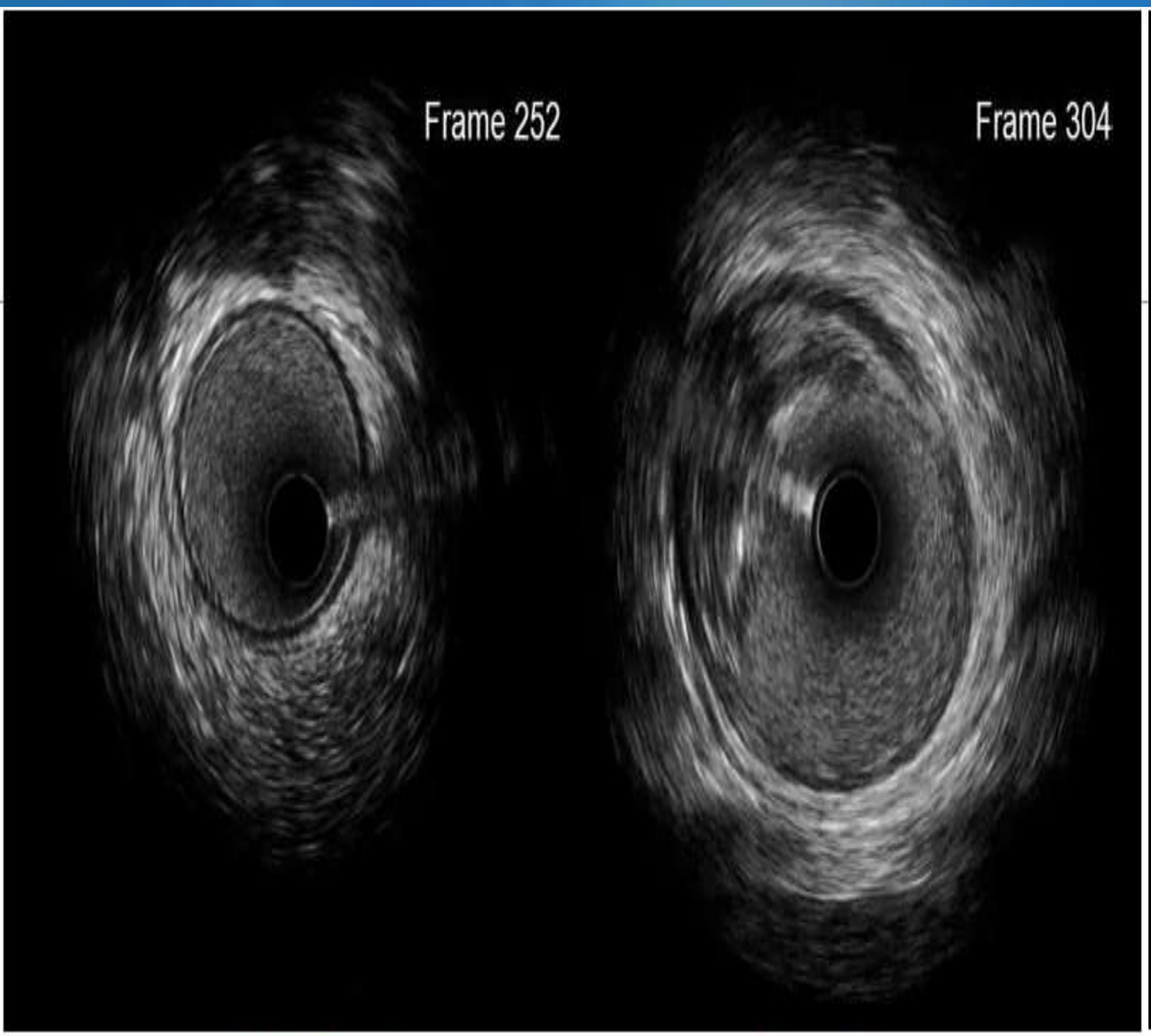
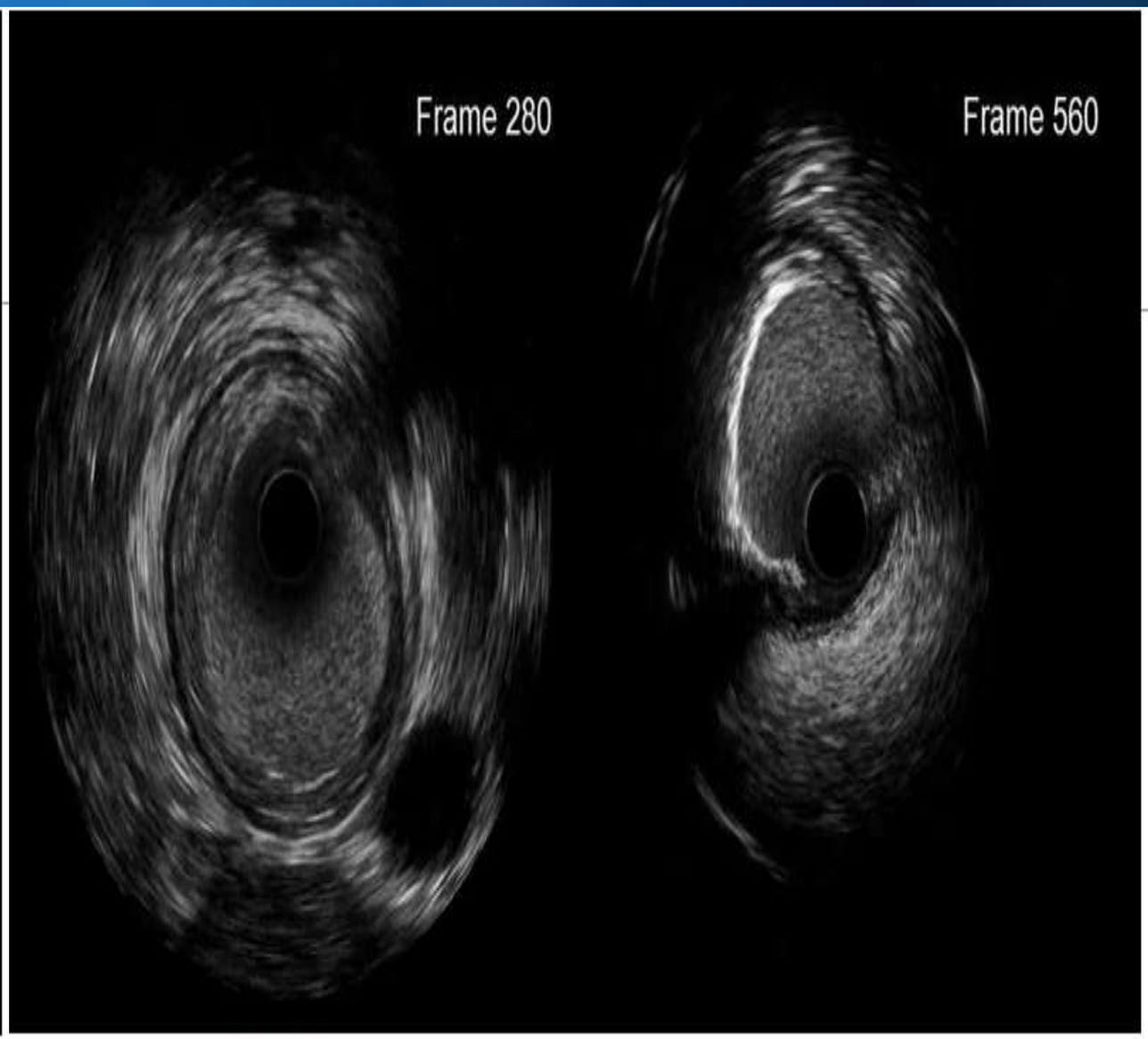



Healthy Vessel

Fibrotic Plaque




Mixed Plaque

Calcific Plaque

# BSC HD IVUS

## OPTICROSS™ HD 60 MHz Image Examples

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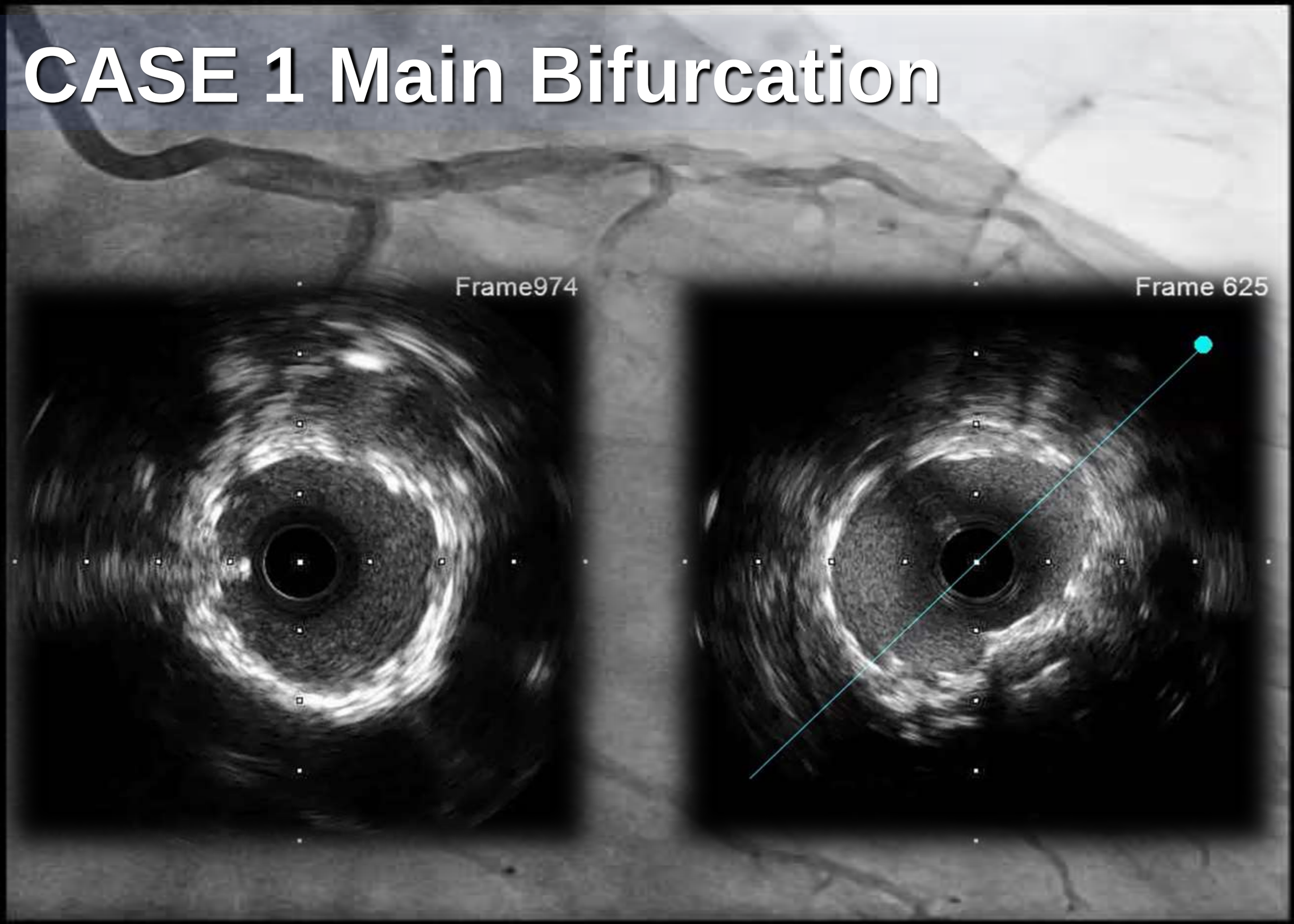
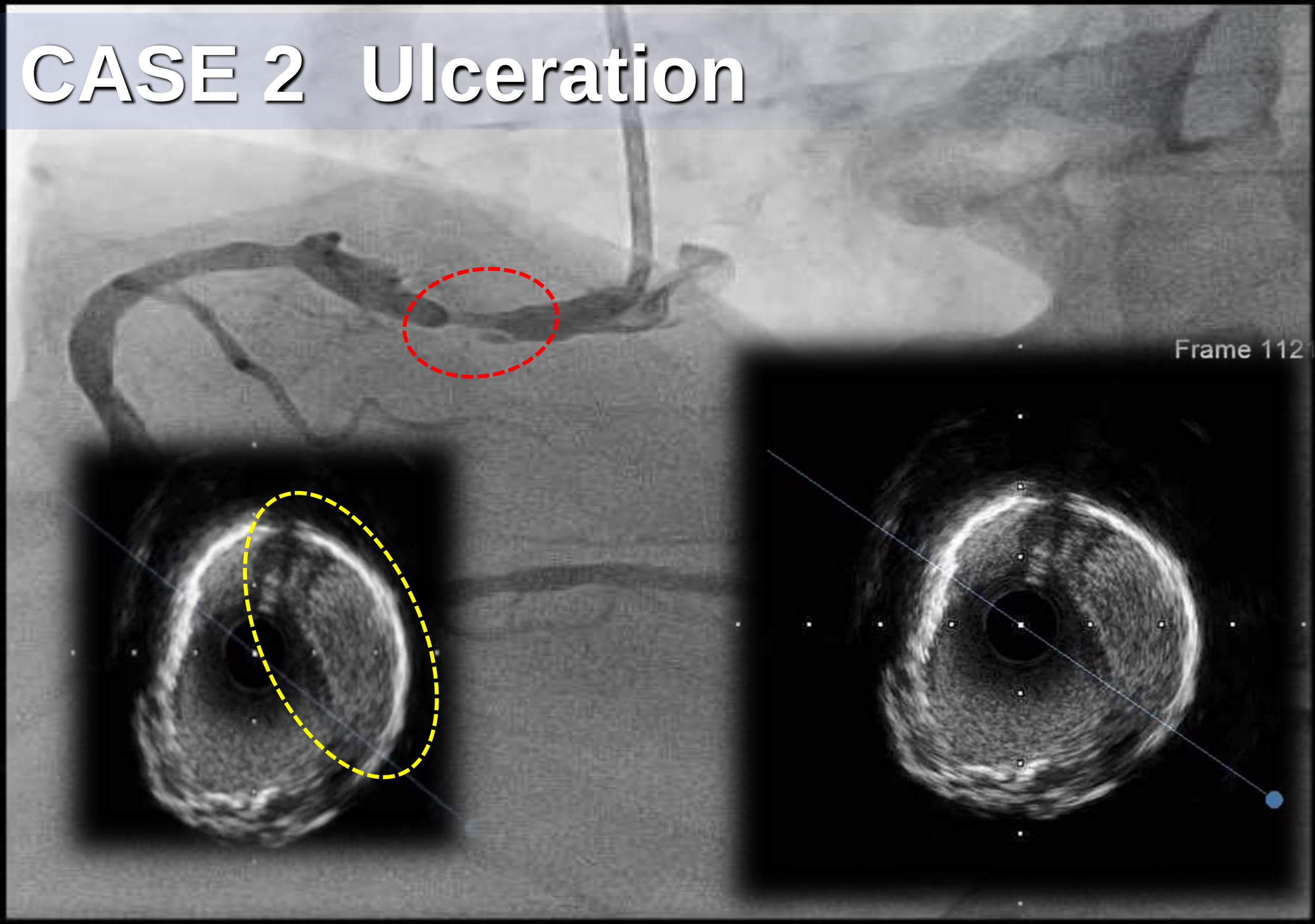
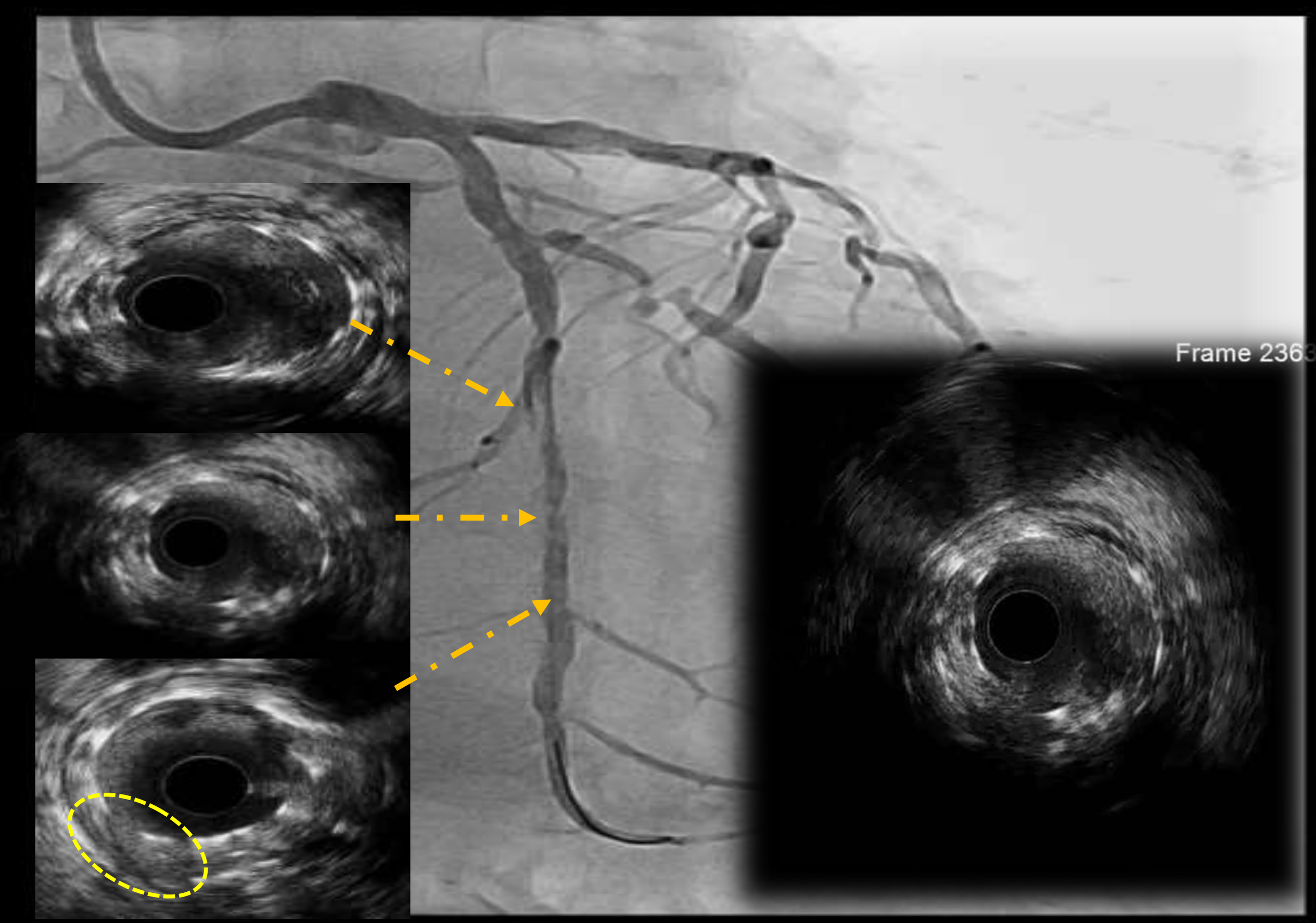
# CASE Image

# CASE 1 Main Bifurcation



# CASE 2 Ulceration



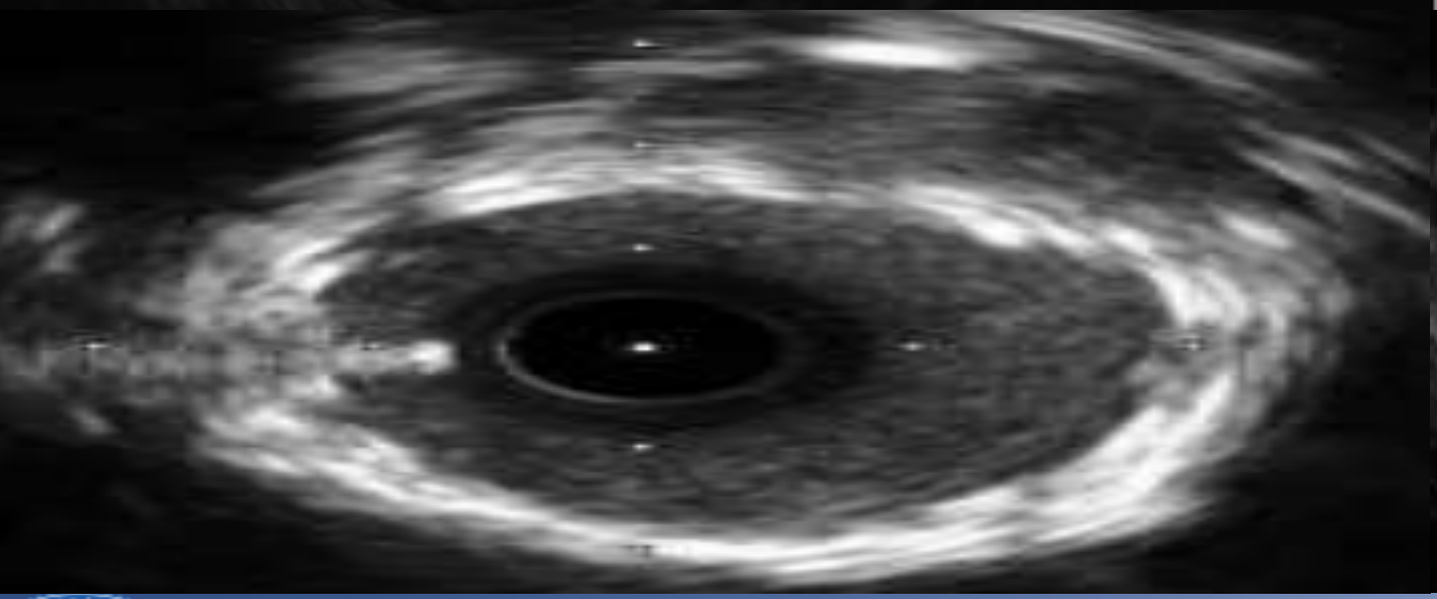

Frame 2363

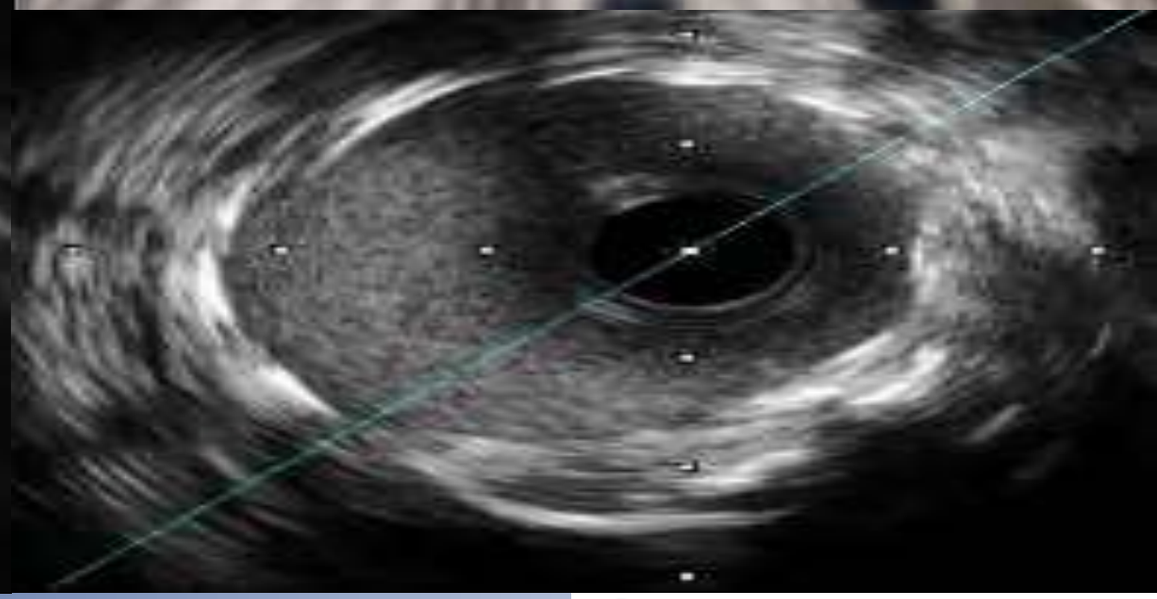
# CASE summery

- IVUS CASE

1.It looks really clean with a better resolution than the past IVUS. (Therefore, TWO STNET part, overlap site, back part of STENT, clear calcium, etc...)

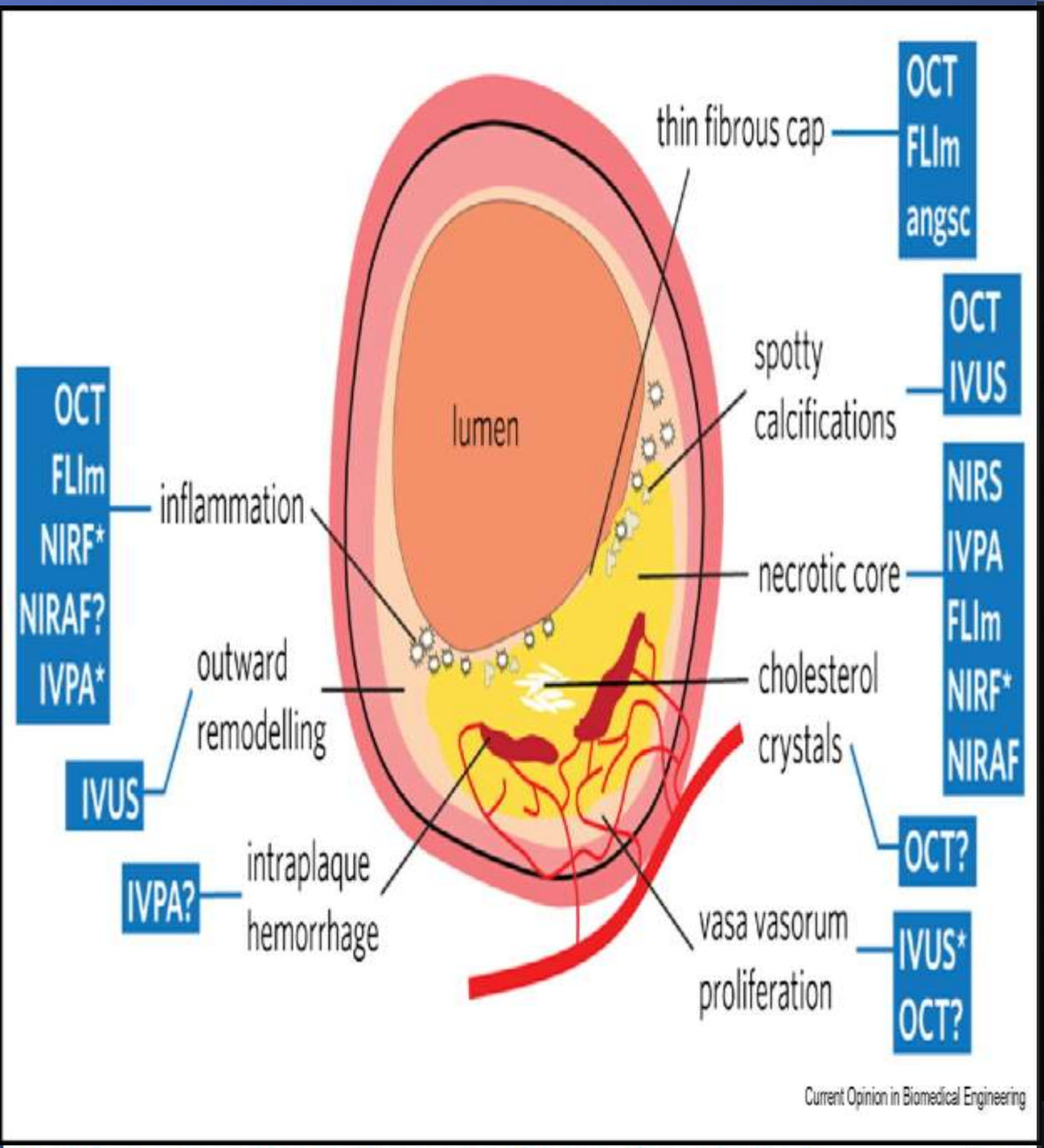
2 Less flush resistance, no air blackout artifacts and better delivery.





# Conclusion

# Today's Message




Update on Cardiac Catheterization in Patients With Prior Coronary Artery Bypass Graft Surgery

Iosif Xenogiannis, MD,[a,b] Peter Tajti, MD,[a,b,c] Allison B. Hall, MD,[a] Khaldoon Alaswad, MD,[d] Stéphane Rinfret, MD,[e] William Nicholson, MD,[f] Dimitri Karmpaliotis, MD,[g] Kambis Mashayekhi, MD,[h] Sergey Furkalo, MD,[i] João L. Cavalcante, MD,[a] M. Nicholas Burke, MD,[a] Emmanouil S. Brilakis, MD, PhD[a,b]

- HD IVUS

1. Good image without vessel clearing
2. More accurate longitudinal (L-Mode) reconstruction Axial lateral 향상 longitudinal (L-Mode) reconstruction 향상
3. A lot of help in future research and procedures
4. But still the main body and full-back speed and soft
5. Still works in progress and expects to develop combinations with other equipment